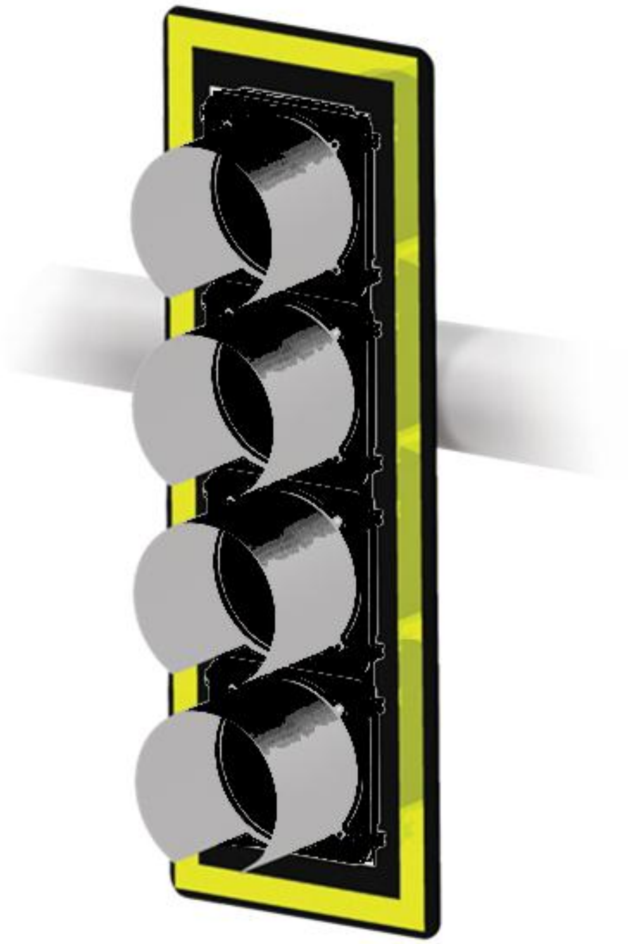
Georgia Department of Transportation



Traffic Signal Design

GUIDELINES

2016 **VERSION 4.2**

Document Revision History

DATE	REV.	SPCR(s)	SECTIONS	DESCRIPTION
11/2000	**Ver. 1**			**Initial release of document**
5/2003	**Ver. 1.1**			**Draft of first major update**
11/2003	**Ver. 1.2**			**Final of first major update**
2/2011	**Ver. 2.0**			**Major update**
12/2013	**Ver. 3.0**			**Major update**
8/2015	**Ver. 4.0**			**Major update**
10/2015	**Ver. 4.1**			**Minor update**
2/2016	**Ver. 4.2**			**Minor update**

List of Revisions

The following list summarizes the most recent revisions and associated page numbers to the Georgia Department of Transportation's latest publication of the Traffic Signal Design Guidelines.

- Page 10: Traffic signal strain poles should be designed to provide adequate clearance for the addition of future left turn phases.
- Page 26-27; 37: Signal head and blank-out sign treatments for railroad pre-emption.
- Page 35: The assignment of side street phases for split phase intersections.
- Page 35: Consideration should be given to avoid creating a left turn trap when entering the pre-emption sequence.
- Page 39; B-5: Signal head treatment for shared through/left travel lanes.
- Page 39: Minimum requirements and engineering judgment for the installation of supplemental signal heads.
- Page 40: Configuration of bi-modal FYA signal heads, bottom section should display both the green and flashing yellow indications.
- Page 45: Options for the installation of atypical vehicle detection.
- Page A-5: Design example for radar vehicle detection.

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List of Abbreviations

AASHTO	American Association of State Highway and Transportation Officials
ADA	Americans with Disabilities Act
EDG	GDOT Electronic Data Guidelines
FDC	Fiber distribution center
FHWA	Federal Highway Administration
FYA	Flashing yellow arrow
GDOT	Georgia Department of Transportation
GRS	Galvanized rigid steel
HDPE	High-density polyethylene
ITE	Institute of Transportation Engineers
IVDS	Intersection video detection system
LED	Light emitting diode
MUTCD	Manual on Uniform Traffic Control Devices, (MUTCD)
PHB	Pedestrian hybrid beacons
PPG	Plan Presentation Guide
PPLT	Protected/permissive left turns
RRFB	Rectangular rapid flashing beacons
TE	Traffic Engineering Study

Section 1 INTRODUCTION

The purpose of these design guidelines is to document standards, procedures and specifications that should be used for the design of traffic signal installations and signal system communications for the Georgia Department of Transportation (GDOT). These design guidelines include a compilation of specific drafting and intersection design standards, plan and specification presentations, and review procedures to ensure that construction documents properly convey the extent and character of the work to be performed. Sound traffic engineering judgment should be exercised in applying these guidelines. Along with the companion document on signing and marking design, this document contains comprehensive guidelines intended to provide for consistency in plans for traffic control devices. Although ramp meters are a type of traffic signal, their design is not covered in this document; reference Chapter 9 of the GDOT ITS Design Manual for more information on ramp meters.

1.1 Applicable Standards and Specifications

Documents listed below provide more detail concerning specific traffic engineering design elements, but all work must be in accordance with the *GDOT Standard Specifications – Construction of Transportation Systems*. Special attention should be given to the specific sections listed under the GDOT Standard Specifications:

- *GDOT Standard Specifications – Construction of Transportation Systems*
  - Section 636 – Signs
  - Section 639 – Poles & Span Wire
  - Section 647 – Traffic Signal Installation
  - Section 682 – Electrical Wire, Cable & Conduit
  - Section 687 – Traffic Signal Timing
  - Section 925 – Traffic Signal Equipment
  - Section 926 – Wireless Communications Equipment
  - Section 935 – Fiber Optic Cable
  - Section 937 – Detection
  - Section 939 – Communication and Electronic Equipment
- *GDOT Standard and Detail Sheets*
- *GDOT Signing and Marking Design Guidelines*
- *GDOT Plans Presentation Guide*
- *GDOT Electronic Data Guidelines (EDG)*
- *GDOT Design Policy Manual*
- GDOT ITS Design Manual

- *Manual on Uniform Traffic Control Devices*, (MUTCD 2009). This document shall govern those aspects of the application of all signs, signals, and pavement markings not specifically covered by the above materials.
- *A Policy on Geometric Design of Highways and Streets*, latest edition adopted by GDOT. Design standards outlined in this publication shall govern most geometric considerations.
- *Americans with Disabilities Act*,(ADA)
- Locating Detectors for Advanced Traffic Control Strategies (Report No. FHWA-RD-75-91), 1975
- Federal Highway Administration (FHWA) Guidelines for System Sensor Placement
- American Association of State Highway and Transportation Officials (AASHTO) Standard Specifications for Structural Supports for Highway Signs, Luminaries, and Traffic Signals. This document provides criteria for structural design.
- FHWA Work Zone Traffic Control Practices Manual
- *Standard Highway Signs (FHWA)*. Wherever possible, designated traffic signs shall be as specified in this document.
- Institute of Transportation Engineers (ITE) Manual of Traffic Signal Design
- *Transportation Electrical Equipment Specifications*, current edition and current addenda. These specifications are referenced by GDOT’s Traffic Signal Equipment specifications.
- *FHWA Railroad-Highway Grade Crossing Handbook*, revised second edition, August 2007

Section 2 GENERAL INFORMATION

All design and construction work will follow the latest version of the GDOT Standard Specifications and Drawings. All signal plan sheets should be oriented the same as the construction plan sheets, but the Department's preference is to orientate the signal design plan sheet with the north arrow up or to the right. Figure 2-1 below shows the preferred orientation of the north arrow. The north arrow should always point within the hatched area of the circle. Traffic control signals are signaling devices that are positioned in a way to control or direct the flow of traffic. Some examples of traffic control devices are 3 section signal heads, advanced warning flashers, school flashers, overhead beacon flashers, and pedestrian hybrid beacons. It should be noted that all traffic control devices require a permit.

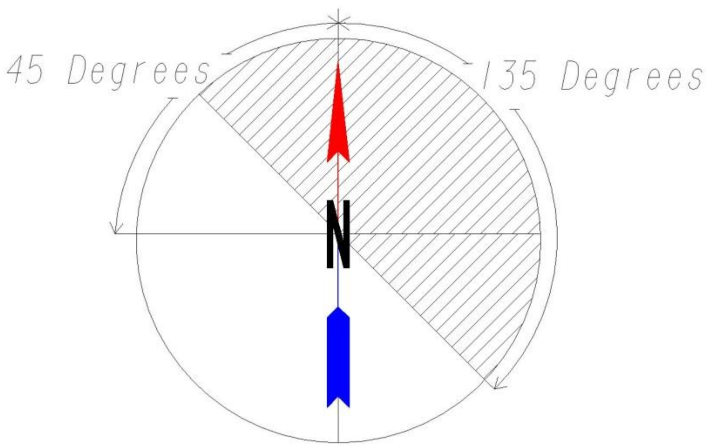


Figure 2-1: North arrow orientation.

2.1 Signal Permitting Process

When making revisions to an existing signalized intersection, the designer should ensure an existing permit has been approved for the given location. The signal permit revision, based on the final plan submission, should be submitted to the District Office.

The following steps should be taken for all new traffic signal permits. First a traffic engineering (TE) study, that includes warrant analyses, preliminary design, and any supporting documents, should be completed and submitted to the District. Once the District Traffic Engineer approves the TE study it is forwarded for recommendation to the State Traffic Engineer, then to the Director of Operations, and followed by the Chief Engineer. After approval by the Chief Engineer the TMC will wait for final design submission to make final approval on the permit. Additional information on the signal permitting process can be found in [GDOT Traffic Signal Policy (6785-1).]()

2.2 Signal Design Process

The following list is provided as a general representation of the steps that should be taken when designing traffic signals. This list is only provided as a guide and not as an all-encompassing checklist.

- Obtain Project Background & Design Data
- Prepare Survey/Base/Existing Plan
- Initial Site visit (where applicable)
- Identify Signal Requirements / Verify with TE reports where applicable
    - Left turn phasing
    - Pedestrian phases
    - Overlaps
    - Preempts
    - Turn restrictions
- Review Geometric Design
- Establish crosswalks, stop lines and review ramp locations
- Identify overhead structure support (span wire/mast arm)
- Locate Signal heads (vehicles/pedestrian) and push buttons
- Locate Signal Poles
- Identify detection method and locate vehicle detectors
- Locate cabinet and power source
- Locate Pull boxes and conduits
- Locate and determine sign requirements
- Locate and design signal interconnect if applicable

2.3 General Signal Plan Presentation

For consistency in signal plan presentation, refer to the latest version of the Plan Presentation Guide (PPG). In general, the signal plan sheets should include traffic signal notes (if they have not already been included in the general note section), legend for symbols, existing (if included) and proposed signal design plans, traffic list of materials with quantities and pay items, cabinet input assignment, and overhead street name sign dimensions. For standalone traffic signal projects, existing traffic signal information should be shown on a separate plan sheet. For more detailed information on drafting standards, file structure, reference files, level structure, and fonts for signal and communication plans, refer to the latest version of the Electronic Data Guidelines (EDG).

2.3.1 Signal Design Plans (Section 27-000)

Traffic signal plans should be formatted with the main street orientated left to right across the page. Traffic signal plan sheets should be designed to be clear and legible on 11-inch by 17-inch plan sheets, showing as much existing/proposed roadway information as possible (edge of pavement, curb and gutter, sidewalk, concrete islands, pavement markings, existing and proposed traffic-signal-related signage, right-of-way). The preferred scale for traffic signal plans is a 1:30 scale; however, other scales should be considered depending on the size and scope of an intersection. All text and fonts should be large enough to read and understand.

Each traffic signal plan sheet should include the following,

- North Arrow
- Graphic scale bar
- Label all street names and speed limits
- Overhead street name signs
- Existing/proposed pedestrian and regulatory signs
- Existing/proposed pavement markings
- Existing/proposed crosswalks and ramps
- Vehicular/pedestrian signal head displays
- Existing/proposed vehicle detection
- Show distance from stop bar to front of pulse loops
- Pole locations (station and offset)
- Phasing diagram
- Traffic signal cabinet
- Right-of-way
- Created/revision/approved date
- Power source/disconnect box location

The existing/proposed information should fill as much of the sheet as possible. Inserts and details may be used if necessary to reduce clutter and clarify construction requirements on the plan sheet. Design information that falls beyond the normal boundaries should be shown using match lines or break lines. Care shall be taken so that necessary information is not omitted whenever these methods are used. The layout of a signal plan sheet is recommended as follows, the phasing diagram in the top left corner, the signal heads in the top right corner, the signs in the lower right corner, and notes in the lower left corner. The placement of these items is only a recommendation and should be moved to different locations on a signal plan sheet if there is clutter in certain area. A legend should be provided, in the lower left corner of the title block, in order to help identify commonly used cells and remove the need to show a callout for every signal component in the installation. Figure 2-2 below shows an example of the recommended signal plan sheet layout. Company logos, scale, revision dates, the office where the signal plan sheets were completed, location of intersection and drawing number should be documented in the title block on the bottom each signal plan sheet. The drawing number should start with “27-1” and with each new plan sheet added to the signal design section the last number should increase by 1 (27-2, 27-3, etc.).

2.3.2 Signal Upgrade Project

Signal upgrade projects should provide all sheets typically included in section 27-000, as well as the following for each intersection: 1) an existing conditions and proposed structures plan sheet and 2) a proposed signal plan sheet. The existing conditions and proposed structures plan sheet should include existing infrastructure, existing utilities, existing right-of-way, and proposed structures (signal pole, utility lines, utility poles, right-of-way, etc). Everything, excluding proposed structures and utilities, should be shown in grayscale on the existing conditions and proposed structures plan sheet. Utilities should not be shown on the proposed signal plan sheets.

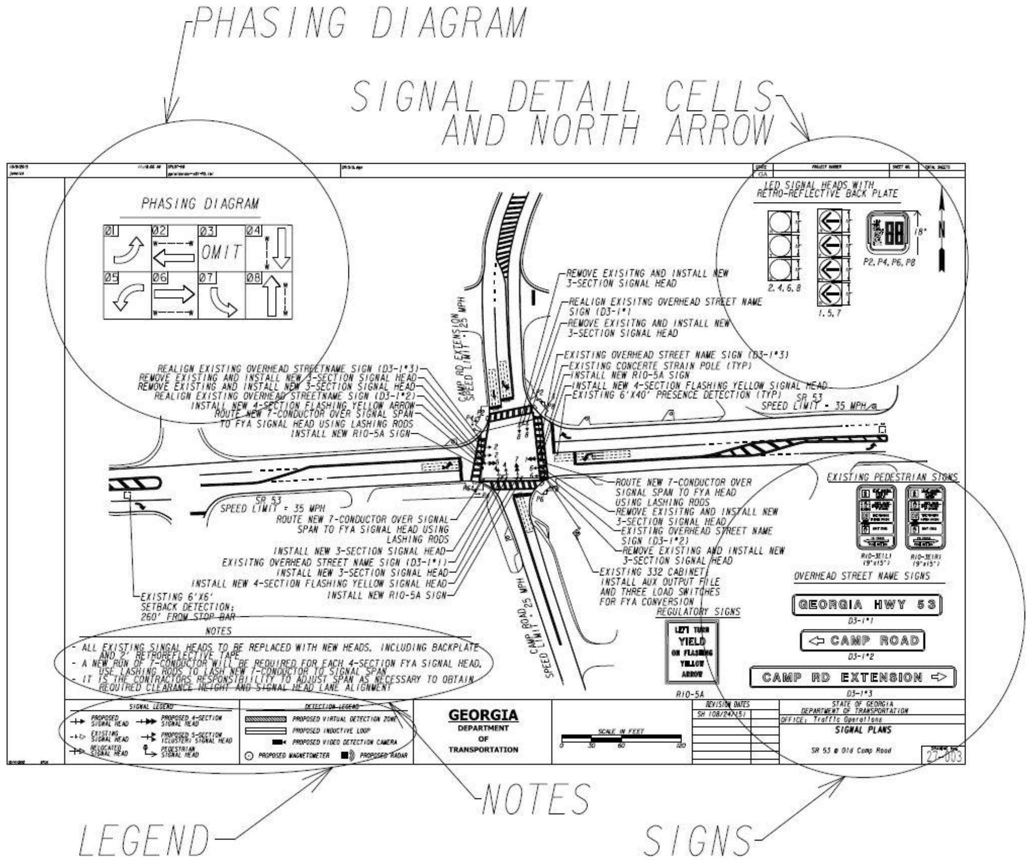


Figure 2-2: Signal plan sheet layout.

2.4 Site Visit

It is highly recommended that a site visit be taken to ensure that all existing characteristics are documented and incorporated in the design. Standard elements that should be documented during a site visit are turn bay lengths, phasing diagrams, detector type and placement, roadway geometry, pedestrian infrastructure, signal head types, and slopes and grades of the roadway. Existing traffic signal equipment and infrastructure, such as conduit, poles, cabinet, etc., should be shown dashed or in gray scale consistent with EDG. Right-of-way should also be shown on signal design plan sheets to confirm the boundaries of the signal infrastructure and equipment.

2.5 List of Materials/Pay Items

A list of materials should be shown on a separate plan sheet and the corresponding quantities are required. It should be noted that this list is for informational purposes only and should not be used for bidding purposes. The following statement should be added to the list of materials plan sheet, **"Note: Quantities are for information only. The contractor should field verify prior to ordering materials."** The list of materials specifies items to be installed and paid for under the lump sum pay item (647-1000 Traffic Signal Installation). Individual pay items should be listed for items included in the signal installation and but covered by the signal lump pay item. For more information on furnishing materials and erecting a traffic signal installation refer to Section 647 of the *GDOT Standard Specifications – Construction of Transportation Systems* . Payment for this work, as defined in Section 647, calls for a lump sum price bid covering all items of work unless pay items are included in the plans for specific items. The latest version of the list of materials is available from the Office of Traffic Operations. The cabinet input file should also be shown on this plan sheet.

2.6 Trenching and Boring

Conduits should be trenched unless the conduit is to be placed under pavement. All conduit installation requiring boring should use Type 3 high-density polyethylene (HDPE) boring conduit. The size of directional bore being used, the number of conduits and the length of the bore should be called out on the plans.

Section 3 TRAFFIC SIGNAL POLES

3.1 Pole Placement

In general, traffic signal poles should be placed outside of the clear zone. The clear zone requirements of the AASHTO Roadside Design Guide should be used to determine the appropriate pole location. In addition to the AASHTO Roadside Design Guide the GDOT Design Policy Manual may be used to determine pole locations. Pole placement should be indicated on the plans by station and offset when the base roadway plans include a construction centerline and stationing. The centerline, not the stationing, should be omitted under a standalone signal design plan set. There are extreme situations were poles may be placed within the clear zone when restricted by existing conditions that are considered major items, including utility lines, guardrail, and limited right-of-way, however, this is not recommended.

GDOT follows the "one pole one corner" rule of thumb when placing poles on the right-of-way. Ideally, there should only be one pole in each corner of an intersection, which would accommodate the traffic signal and all utilities. All existing strain, timber, and joint use poles must be called out on the signal plan sheet.

3.2 Strain Poles

Traffic signal strain poles are specified as Type IV poles in accordance with Section 639 and Section 647 of the *GDOT Standard Specifications – Construction of Transportation Systems*. It should be noted that the specifications require the contractor to submit pole and foundation calculations as well as shop drawings to the districts for review and approval. Strain poles can be made of either steel or reinforced concrete. All new poles placed at an intersection should be constructed of the same material and according to GDOT specifications. Special attention must be given to proposed strain pole foundations in order to avoid conflicts with adjacent utilities, buildings, etc. The designer should survey the area for existing utilities and avoid any conflicts.

3.3 Timber Poles

Timber poles are commonly used for temporary signals. The use of timber poles may be allowed at locations where sufficient right-of-way is available to accommodate any needed down guys while maintaining clear zone requirements. Class II timber poles will be specified when timber poles are used for signal spans. Class IV timber poles may be used only for installing aerial loop lead-in wire or communications cable.

3.4 Joint Use Poles

The designer should always consider using joint use poles and coordinate with the Office of Utilities and utility companies. The designer may be required to provide load calculations to the utility company. Existing timber poles are not recommended for joint use.

Section 4 OVERHEAD SUPPORT STRUCTURES

The use of strain poles and span wire is the preferred support method for traffic signal heads and overhead signs. Any attachments to overhead support structures should always adhere to the manufacturer's specifications.

4.1 Span Wire Configuration

It should be noted that span wire configurations should be designed to allow for 17 foot minimum (19 foot maximum) signal head clearance at a 2.5% minimum sag for timber poles and 5% minimum for stain poles. A helper cable may be required on any timber supported span wire arrangement where a span length exceeds 150 feet (measured pole to pole); a note should be made in the general notes plan sheet when helper cables are required. Span wire allows for the placement of signal heads in the near-optimal viewing position without overly restricting the placement of strain poles. A span wire configuration also allows for pole placement outside of the clear zone. Strain poles intended for span wire configuration should be designed to provide adequate clearance for the addition of left turn phases (i.e. FYA signal heads), even if left turn phases utilized at the existing intersection.

There are several types of span wire configurations. The most preferred and most common type of span wire configuration is the modified box span. Other options are the box span, diagonal span, H-span, Z-span, and X-span. These are described in detail in the *ITE Manual of Traffic Signal Design.* Span wire configurations should be evaluated on an intersection–by-intersection basis in order to achieve optimal head placement while satisfying criteria for pole placement.

4.2 Mast Arm Configuration

Mast arm installations are most commonly used in urban and suburban locations. It should be noted that the specifications require the contractor to submit pole and foundation calculations as well as shop drawings for review and approval. Steel strain poles are typically used at intersections when mast arms are installed. It should be noted that the use of decorative mast arms are allowed but not included under GDOT standard installation. However, if an agency or local jurisdiction chooses to install a decorative mast they will be required to cover the associated expenses. The use of mast arms limits options for pole placement; special care should be taken when placing poles for mast arms. It is essential to evaluate intersection geometrics, underground utilities and available right-of-way to determine how a suitable signal head layout, meeting MUTCD alignment and setback standards, can be achieved using mast arms. Mast arms can be mounted with either one arm or two arms per pole. Two arm poles are larger, but fewer poles are needed per intersection.

Mast arms vary in length, but most are between 20 feet and 65 feet long in 5 feet increments. Mast arm lengths should be called out on the signal plan sheet. Exceptions to the 65-foot limit for mast arm assemblies require the approval of the Chief Engineer and the Bridge Design Office on a case-by-case basis. Consideration should be given to providing sufficient room to construct a large pole foundation if long mast arms are to be used. Mast arm lengths should be designed to consider potential future traffic signal phases and/or lane configuration changes (e.g. left turn phase/lane additions).

Section 5 PEDESTRIAN INFRASTRUCTURE

The GDOT Traffic Signal Policy (6785-1) states: "Crosswalks and pedestrian signal heads (see Section 14: PEDESTRIAN SIGNAL HEADS), including ADA considerations, shall be installed on all approaches of new traffic signal installations or revised traffic signal permits unless an approach prohibits pedestrian traffic." New and revised stop and go traffic signals, pedestrian hybrid beacons (PHB), and rectangular rapid flashing beacons (RRFB) should all be submitted through the districts and then Office of Traffic Operations. The previously mentioned pedestrian infrastructure could be excluded in situations where a pedestrian pathway or landing would be unsafe (e.g., guardrail at the face of curb and gutter, etc.) or when it is genuinely accepted as unnecessary (inside leg of a diamond interchange). All exceptions must be approved by the State Traffic Engineer. Justification for not providing pedestrian accommodations for all approaches must be documented in the signal permit file. Refer to *GDOT's Pedestrian Crossing Guidelines* and *Pedestrian and Streetscape Guide* for additional information about the design of the pedestrian crossing.

5.1 Pedestrian Push Button Assembly

Refer to the current MUTCD and ADA requirements for correct placement of pedestrian buttons and poles. Pedestrian pushbutton assemblies should be installed within 10 inches of the sidewalk or landing. Pedestrian pushbutton poles should be located no more than 6 feet from the travel lane. Pushbutton assemblies will have an integral sign mount.

When multiple curb ramps are provided for a single radius, multiple push button assemblies should be provided. When there are two pushbutton stations, they should be separated by a distance of at least 10 feet. The appropriate location for pedestrian push buttons is shown in Figure 5-1 below.

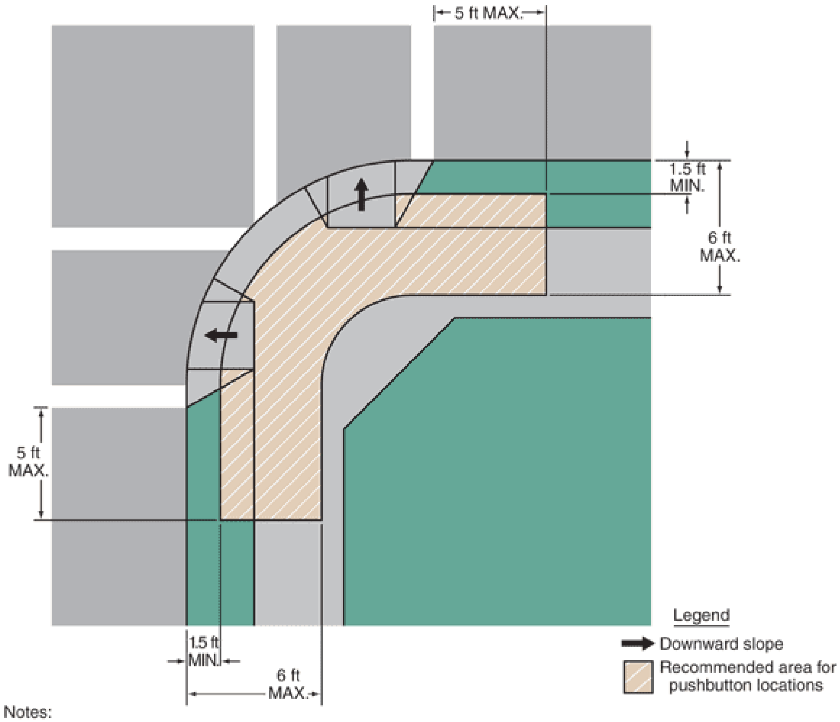


Figure 5-1: Pushbutton location area (Source: 2009 MUTCD Figure 4E-3)

When the pedestrian push button assembly is placed in a raised island, one pedestrian pole should be located in the area least likely to be hit by vehicles. If a pedestrian pole is located a significant distance from a ramp and crosswalk, an additional pedestrian pole may be installed. See Section 3.4.3 for further information on pedestrian refuge islands.

5.2 Curb Ramps

For detailed information regarding the design of ADA compliant ramps see GDOT Construction Details A-3 and A-4. All curb ramps or pads shall include a detectable warning that extends the full width of curb ramp (exclusive of the flared sides) and shall extend either the full depth of the curb ramp or 24 inches minimum measured from the back of the curb on the ramp surface. The detectable warning must contrast visible with the adjacent sidewalk. The current ADA and other Standard Details Sheets are available from GDOT's R.O.A.D.S website

For each approach where crosswalks are provided, curb ramps meeting the provisions of the ADA should be provided. In general, curb ramps should be designed with a separate ramp for each crosswalk, guiding pedestrians directly into the crosswalk, rather than one ramp in the center of the radius. When sidewalks are not provided, a concrete pad (meeting ADA landing area requirements) will be installed for each crosswalk approach. A paved path should be provided between the curb ramp and the pedestrian pushbuttons. The placement of curbs and ramps may be justified in rural areas when an intersection is newly constructed or reconstructed. More information regarding curbs and ramps in rural areas may be found in the *Pedestrian and Streetscape Guide*.

5.3 Pedestrian Refuge Islands

Refer to the GDOT Driveway and Encroachment Control Manual, Chapter 4J, for details on raised concrete islands. When concrete islands are placed within an intersection, pedestrian signal heads, pushbutton assemblies, and curb ramps should be installed within the island, provided that the island is of sufficient size (75 square feet at a minimum, 100 square feet preferred). When the island is not of sufficient size to use traditional ADA ramps, a semi-depressed cut-through island should be used (shown in Figure 5-2 below). Traditional cut-through islands at road grade should be avoided due to maintenance issues.

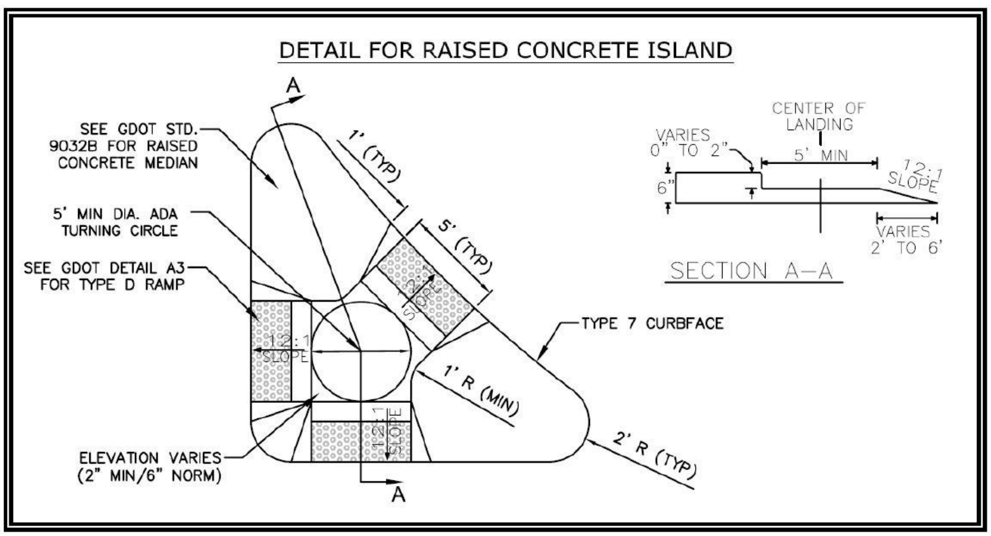


Figure 5-2: Semi depressed Cut Through Island (Source: GDOT Driveway and Encroachment Control)

Pedestrian refuge islands are also used in the design of a two-stage PHB crossing. The PHB refuge island should have an angled or Z shaped (See example 9 in Appendix A: Traffic Signal Plan Examples) cut-through which faces the pedestrian towards oncoming traffic as they are crossing.

Elongated pedestrian refuge islands, shown in Figure 5-3, provide a better angle for driver visibility. This design should be used when installing or reconstructing concrete islands for channelized right turns.

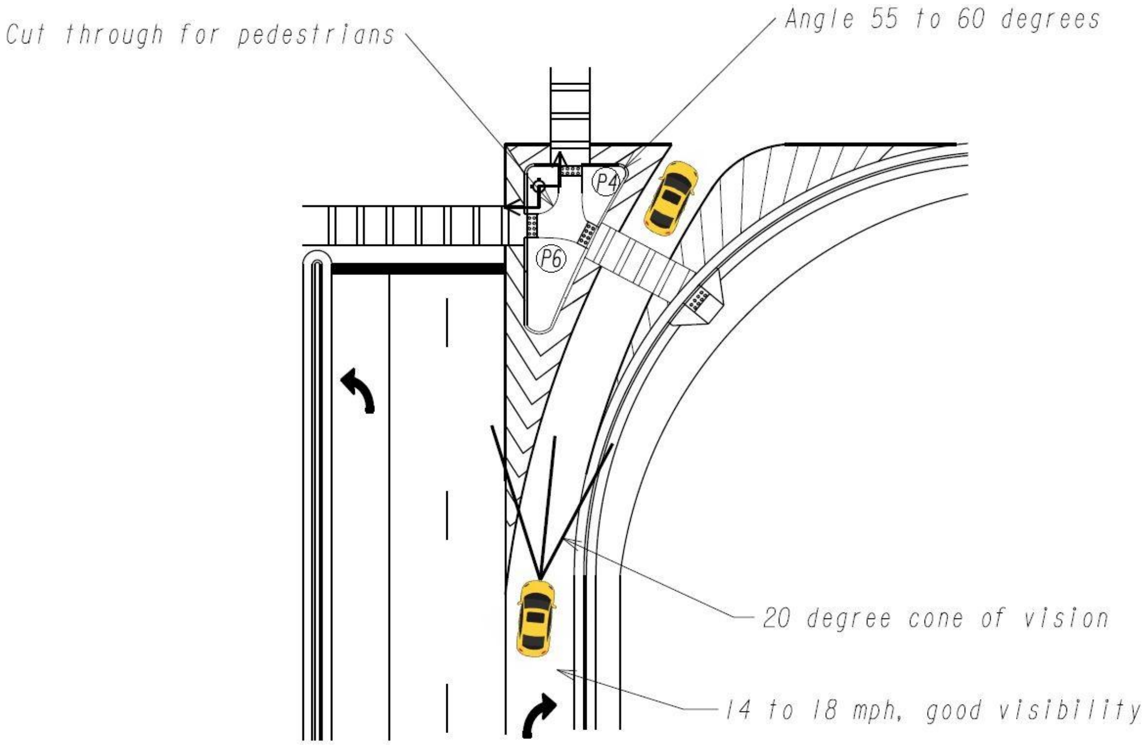


Figure 5-3: Elongated Refuge Island at Right-Turn Slip Lane.

5.4 Other Pedestrian Active Control

Other pedestrian active control, such as PHB and RRFB, can be considered when designing pedestrian facilities. PHB is a special type of hybrid beacon used to warn and control traffic at a signalized location to assist pedestrians in crossing a street or highway at a marked crosswalk. The design of a PHB is governed by the total amount of vehicles on both approaches per hour, speed, and total amount of pedestrian crossing per hour on the main street. A PHB can be single or dual staged depending on the presence of a median in the roadway. Examples of a single

(Example 8) and dual stage PHB (Example 9) can be found in Appendix A: Traffic Signal Plan Examples. Additional information on PHB can be found in Chapter 4F in the MUTCD.

RRFBs are used when current standards for flashing beacons in the MUTCD are not satisfied. RRFB are warning beacons that supplement standard pedestrian crossing warning signs and markings at either a pedestrian or school crossing; where the crosswalk approach is not controlled by a yield sign, stop sign, or traffic control signal; or at a crosswalk at a roundabout. Additional information, such as visibility requirements and pushbutton locations, on RRFB can be found in Section 925.2.50 of the *GDOT Standard Specification*. An example of an RRFB (Example 7) can be found in Appendix A: Traffic Signal Plan Examples.

Section 6 CABINET ASSEMBLIES

A traffic signal design should provide installation details for the cabinet, base, model 2070 controller, input file, and power disconnect. Details may also be required for additional installations such as battery backup systems or various communications devices. The following sections describe GDOT specified items which may be required in a controller assembly.

6.1 Cabinet and Cabinet Bases

Cabinets for signal controllers should be Type 332, 336S or 337. The primary cabinet used by GDOT is the 332 cabinet with an auxiliary output file. The 332 should be used in most cases where a ground mount cabinet is feasible. Where conditions require a more compact or pole mounted cabinet, the 336S cabinet may be used. Prefabricated bases should be used for all new ground-mounted cabinet installations. The 332 and 336S cabinets use the same size base. All cabinets using a battery backup should have an extended base for mounting the battery backup cabinet.

The cabinet should be oriented such that maintenance personnel can view the signal faces while facing the controller. The cabinet should be located on level terrain and near the back edge of right-of-way where practical. Areas prone to collecting water should be avoided. Consideration should be given to minimizing the chances of the cabinet being struck by errant vehicles, maintenance equipment, etc. Cabinet placement should not obstruct the minimum sight distance. The cabinet location should also not obstruct the sidewalk, even when the doors are open. Care should be taken such that doors do not open off the right-of-way.

6.2 Input File

Each traffic signal design should include a diagram of the cabinet input file on a separate plan sheet, indicating the slots to be used, and the types and functions of the cards to be installed. The following abbreviations are used in the input file diagram:

- TYPE –Indicates the slot’s assigned input type (either DET, DC, AC or TBA)
    - DET – Reserved for vehicle detector inputs
    - DC – Reserved for low voltage input
    - AC – Reserved for 115 volt input

  - TBA (To Be Announced) – Available for user assignment
- CARD – Type of input isolator (e.g., 2-CH loop, 4-CH loop, DC isolator, intersection video detection system (IVDS), expansion modules, etc.)
- Function – This is the designation for the input hook-up. For example, Ø1 (or L1) would designate the loop detector that is associated with Phase 1. Preemption functions when required are noted as R/R for railroad and EVD, EVC for emergency vehicles.

6.2.1 Cabinet Input Assignments

Table 6-1 and Table 6-2 below indicate the type of input device that is to be inserted into each slot for a Type 332 and 336S cabinet. Contact the GDOT District Signal Engineer for their preference on swapping the inputs for the left turn phases (phase 1 and 5 and phase 3 and 7).

The slots within the input assignment chart should be populated by simply turning on and off the appropriate layers. In a 332 cabinet, the detector cards are inserted in slots 1 through 8. Slot 9 is used for an additional detector card and slots 10 and 11 are for other equipment. Slots 12 through 14 are for DC isolators. Slots 12 and 13 are for DC isolators used to generate controller inputs from the contact closure created by activation of the pedestrian pushbuttons. Slot 14 will always contain a DC isolator that is used for flash sense and stop time. In a 332 cabinet, slots 12 through 14 in the lower input file are used for railroad and emergency vehicle pre-emption.

The 336s cabinet does not consist of a lower input file. Slots 1 through 8 are for detector cards and slots 9 through 11 are used for railroad and emergency vehicle pre-emption. Slots 12 through 14 are for DC isolators for pedestrian pushbuttons and flash as with the 332 cabinet.

Table 6-1: 332 Example Cabinet Input Assignment

Table 925 – 4 Model 332 Default Input Files Assignment Detail																
Upper Input File (I)	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Type		Det	Det	Det	Det	Det	Det	Det	Det	Det			DC	DC	DC
	Channel 1	C1 Pin	56	39	63	47	58	41	65	49	60		80	67	68	81
		Function	Ph1	Ph2	Ph2	Ph2 CALL	Ph3	Ph4	Ph4	Ph4 CALL	Ph1		INT ADV	Ph2 PED	Ph6 PED	FLASH
		Field Term	TB-2 1,2	TB-2 5,6	TB-2 9,10	TB-4 1,2	TB-4 5,6	TB-4 9,10	TB-6 1,2	TB-6 5,6	TB- 6 9,10		NC	TB- 8 4,6	TB- 8 7,9	NC
	Channel 2	C1 Pin	56	43	76	47	58	45	78	49	62		53	69	70	82
		Function	Ph1	Ph2	Ph2	Ph2 CALL	Ph3	Ph4	Ph4	Ph4 CALL	Ph3		MCE	Ph4 PED	Ph8 PED	STOP TIME
		Field Term	TB-2 3,4	TB-2 7,8	TB-2 11,12	TB-4 3,4	TB-4 7,8	TB-4 11,12	TB-6 3,4	TB-6 7,8	TB-6 11,12		NC	TB-8 5,6	TB-8 8,9	NC
Lower Input File (J)	Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14
	Type		Det	Det	Det	Det	Det	Det	Det	Det	Det			TBA	TBA	DC
	Channel 1	C1 Pin	55	40	64	48	57	42	66	50	59		54	71	72	51
		Function	Ph5	Ph6	Ph6	Ph6 CALL	Ph7	Ph8	Ph8	Ph8 CALL	Ph5			EVA	EVB	R/R
		Field Term	TB-3 1,2	TB-3 5,6	TB-3 9,10	TB-5 1,2	TB-5 5,6	TB-5 9,10	TB-7 1,2	TB-7 5,6	TB- 7 9,10			TB- 9 4,6	TB- 9 7,9	TB- 9 10,12
	Channel 2	C1 Pin	55	44	77	48	57	46	79	50	61		75	73	74	52
		Function	Ph5	Ph6	Ph6	Ph6 CALL	Ph7	Ph8	Ph8	Ph8 CALL	Ph7			EVC	EVD	
		Field Term	TB-3 3,4	TB-3 7,8	TB-3 11,12	TB-5 3,4	TB-5 7,8	TB-5 11,12	TB-7 3,4	TB-7 7,8	TB-7 11,12			TB-9 5,6	TB-9 8,9	TB- 9 11,12

Table 6-2: 336 Default Cabinet Input Assignment

Table 925-6 Model 336S Default Input File Assignment Detail															
Slot		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Type		Det	Det	Det	Det	Det	Det	Det	Det	DC	TBA	TBA	DC	DC	DC
Channel 1	C1 Pin	56	39	58	41	55	40	57	42	51	71	72	67	68	81
	Function	Ph1	Ph2	Ph3	Ph4	Ph5	Ph6	Ph7	Ph8	SE1	EVA	EVB	Ph2 PED	Ph6 PED	FLASH
	Field Term	TB-7 1,2	TB-7 5,6	TB-7 9,10	TB-8 1,2	TB-8 5,6	TB-8 9,10	TB-9 1,2	TB-9 5,6	TB- 5 1,2	TB- 5 5,6	TB- 5 9,10	TB- 4 1,2	TB- 4 5,6	NC
Channel 2	C1 Pin	47	43	49	45	48	44	50	46	52	73	74	69	70	82
	Function	Ph2 CALL	Ph2	Ph4 CALL	Ph4	Ph6 CALL	Ph6	Ph8 CALL	Ph8	R/R	EVC	EVD	Ph4 PED	Ph8 PED	STOP TIME
	Field Term	TB-7 3,4	TB-7 7,8	TB-7 11,12	TB-8 3,4	TB-8 7,8	TB-8 11,12	TB-9 3,4	TB-9 7,8	TB-5 3,4	TB-5 7,8	TB-5 11,12	TB-4 3,4	TB-4 7,8	NC

6.3 Battery Backup/Uninterruptable Power Supply

Battery backup should be used at intersections that are considered to be critical and would require a steady supply of power (e.g., a multi-lane road intersects another multi-lane road, railroad preemption, intersections with sub-standard sight distance, etc.). Contact the GDOT District Office and/or the maintaining agency to confirm need for battery back-up.

6.4 Power Disconnect

A power disconnect box shall be installed for each cabinet at each intersection. The disconnect box allows the power to the cabinet to be cut off in the event that a signal installation is damaged and live wires are on the ground. The power service feed location for each intersection should be indicated on the sign design plans for all new installations. In addition the meter base assembly should also be called out on the signal plans for each intersection. Meter base assembly should be installed on the mast arm/strain pole, pedestal mount, or the cabinet. For aerial power service feeds, the disconnect box should be located near the top of the signal pole that is adjacent to the controller cabinet. For underground power service feeds, the disconnect box should be located on a power pedestal near the signal cabinet. All exposed conduit should be galvanized rigid steel (GRS) conduit. Coordinate with the GDOT District Signal Engineer on the location preferences of disconnect boxes. Refer to Example 10 in Appendix A: Traffic Signal Plan Examples for the traffic signal detail electric power service detail.

Section 7 COMMUNICATION/INTERCONNECT

For the installation of communication devices refer to Section 926, 935, and 939 of the GDOT Standard Specifications. All traffic signals shall be designed to have IP communications back to a central server. Available communication devices include wireless transceivers, field switches, and cellular routers. 4G routers should be used as the preferred option for connection traffic signal cabinets to the central server. Fiber should only be installed where necessary due to high band width requirements such as when connecting CCTVs or when linking multiple signals together.

not interconnected with fiber optic or wireless communications should utilize a 4G Cellular Router (Type A or B). The proper type of communication device should be specified depending on the type of system. The District Traffic Operations Office will determine which type of communication is appropriate.

The guidance in this section is limited to fiber optic cable design for signal interconnect systems. An expanded discussion of fiber optic cable design is available in the *GDOT ITS Design Manual.*

For fiber optic installations, all fiber cable should be single mode. Each cable run will be assessed to determine the size of cable to be installed. The recommended cable fiber count is 72, allowing the minimum cable size to be 48 fiber count cable; 12 fiber drop cable with 8 splices should be used at most equipment drops. The final cable count size should be approved by the District Signal Engineer.

Fiber optic communication cables may be run aerially or in underground conduit. An underground system should consist of fiber optic cable installed in conduit and pull boxes. Between signals, pull boxes should be spaced no more than 750 feet apart and each shall have a maintenance coil of 110 feet of trunk fiber. A Type 6 or 7 pull box should be used at locations where maintenance coils are specified, and a Type 7 pull box is required at splice closure locations and each cabinet/intersection. An aerial system should consist of a Type 6 pull box at each cabinet/intersection and aerial closures. When attaching an aerial line to a utility line, service pole GRS risers will be needed to run fiber down timber poles at equipment drop locations. One maintenance coil of 150 feet of trunk fiber should be placed approximately half the distance between every equipment drop, or every 1,000 feet of uninterrupted cable length where equipment drops are greater than 1,000 feet. See Section 935 of the GDOT Standards Specifications for additional information.

A wireless system consists of the installation of a wireless radio and antenna termination panel inside the traffic signal cabinet connecting to an antenna mounted on the signal pole. See Section 926 of the GDOT Standards Specifications for additional information.

The equipment in the cabinet should consist of a FDC and an external transceiver or field switch. The FDC, wireless transceiver, or field switch should be called out on the signal plans. The unterminated FDC is preferred while the pre-terminated FDC should be used if there are space constraints inside the cabinet. The designer should contact the maintaining agency to determine whether an external transceiver or field switch should be used for signal interconnect. Signal interconnect should be shown on Section 28 plan sheets. The fiber optic drop cable is used to connect the modem/field switch in the controller cabinet to the trunk fiber cable. A typical signal installation should have six fibers spliced into the trunk fiber, three in each direction. This will provide four fibers for transmitting and receiving data and two spare fibers as a backup. When selecting an GBIC, care should be taken to ensure the correct device is chosen based on the length of the fiber. See section 939 of the *GDOT Standard Specifications*, for further details on GBIC devices.

Section 8 WIRING STANDARDS

Wiring standards (installation and material) for signal heads, pedestrian heads, pedestrian pushbuttons and loop detectors are defined in Section 647 and Section 925 of the *GDOT Standard Specifications*.

Detector loops should run to a pull box located a maximum of 10 feet behind the edge of pavement or behind the sidewalk within 75 feet of the edge of the loop. At that point, the loop wire should be spliced to shielded lead-in cable, which should be run to the controller. Three-pair shielded cable should be used for all detector lead-ins. One three-pair lead-in cable can be used for up to three loops if a four channel detector card is used. More than three loops would require two lead-in wires. A single lead-in cable shall only control loops for a single phase; multiple lean-in cables may be required for a single approach.

A separate four, seven, or ten conductor cable should be run to each approach of an intersection that has traffic signal heads, based on conditions and requirements. For FYA retrofits, an additional seven conductor cable can be run to each approach with FYA signal heads. In addition, a seven-conductor or four-conductor cable should be run to serve the pedestrian signals at each location where pedestrian signals are provided. If two pedestrian poles are used on one corner, there may either be two separate runs of seven-conductor cable (one to each pole) or a single run of seven-conductor that is run to the first pole, spliced to a jumper seven-conductor cable, and then run to the second pole, at the discretion of the local maintaining agency.

Section 9 CONDUIT and PULLBOXES

The cabinet, signal poles, and pedestrian poles should have separate pull boxes. The placements of cable, conduit, and pull boxes will be in accordance with Section 647 of the *GDOT Standard Specifications*. Conduits will be routed to a pull box adjacent to the cabinet and then routed into the cabinet base. GDOT considers a maximum 40% fill of conduit to be sufficient. A spare conduit is not required at every bore. A detailed explanation of the appropriate use of each type of pull box, along with sizes and placement specifications, can be found Section 925 of the *GDOT Standard Specifications*. Contact the GDOT District Office for preferences on pull box types. The maximum length of conduit between pull boxes for fiber optic cable is 750 feet. Conduit for loop lead-ins should not contain runs over 200 feet between pull boxes unless a shorter distance is specified by district. When conduit is run for distances of 20 feet or less, Type 2 conduit should be used. For distances greater than 20 feet, Type 3 conduit should be used. Contact the GDOT District Traffic Operations Office for preference on distance between pull boxes.

In general, the following conduit sizes shall be used:

- Loop Lead-Ins – 2 inches
- Signal Cable – 2 inches
- Fiber Optic Cable (48, 24, and 72 fiber single mode) – 2 inches
- Power Service – 1 inch (GRS)
- Spare Conduit – 2 inches
- Telephone Service – 1 inch
- Rigid Conduit – 2 inches

Communications equipment should be in its own pull box when feasible. Power service and telephone drops should be installed in separate pull boxes and conduits. Signal cables should be installed in separate conduits, but they can be run into the same pull box used for loop cables. Loop lead-ins, pedestrian pushbutton cables, and communication cables may be installed in the same conduit; however, it is preferred to isolate communications cable from loop lead-in and pedestrian pushbutton cables. See Trenching and Boring for information on direction boring.

Section 10 TRAFFIC SIGNAL RELATED SIGNS

Traffic signs should be specified according to the MUTCD and GDOT Signing and Marking Guidelines. There are two ways a sign may be displayed in an intersection, by post or by hanging them on a mast arm or span wire. All post-mounted signs, not including the signs hung on span wire or mast arms, should be paid for under Signing and Marking pay items and placed on the Signing and Marking plan sheets. If Signing and Marking plan sheets are not included the signs should be paid for under the signal installation upgrade pay items and placed on the Signal Design plan sheets. Three types of signs will be discussed in this section, regulatory, overhead street name, and pedestrian signs.

10.1 Regulatory Signs

Sign installations will be post-mounted in accordance with the MUTCD and GDOT's Signing and Marking Guidelines. Regulatory signs may be post-mounted, placed on a mast arm, or hung on a span wire. All regulatory signs placed on a mast arm or hung on a span wire must be shown on the Signal Design plan sheet. Microstation sign cells should be shown and labeled at the installation location and summarized on same the plan sheet under the heading "Regulatory Signs." (see Example 1 in Appendix A: Traffic Signal Plan Examples). In order to minimize clutter on the mast arm or span wire, the list provided below can serve as a guideline for situations that may warrant the installation of overhead regulatory signing in lieu of a post-mounted sign. It should be noted that each individual occurrence must be properly studied and GDOT approved before a final determination is made.

- Traffic volumes at or near capacity
- Complex intersection and/or signalization design
- Three or more traffic lanes in each direction
- Restricted sight distance
- Closely spaced intersections
- Multi-lane turns
- High percentage of truck traffic
- Very high travel speeds
- Insufficient space for ground signs
- Dropping a through lane as a turn-only lane

The only post-mounted signs that should appear on a Signal Design plan sheet (for permitting purposes) are the R560-5 signs (STATE LAW STOP FOR PEDESTRIANS IN CROSSWALK

SIGN) and R1-2 signs (YIELD SIGN). Variations of these signs should be used at all signalized locations that have free-flowing or yield-controlled right turn channelized islands. R1-2 signs should also be installed at all right turn lanes separated by a physical concrete island that does not have a dedicated receiving lane. The locations of the R560-5 and R1-2 signs can be found in Figure 10-1. At locations without physical islands, a stop bar should be extended across the right turn lane and a R1-2 sign should not be installed.

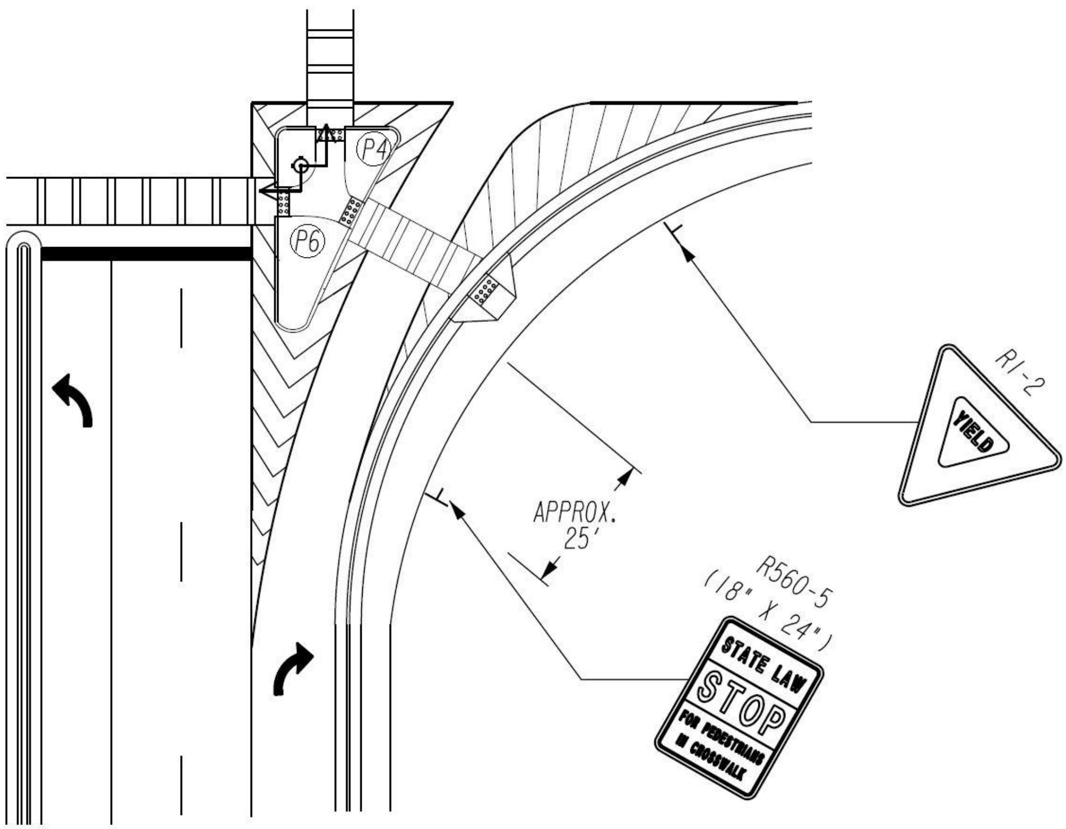


Figure 10-1: Typical Pedestrian Treatment at Right-Turn Islands

Intersections designed for railroad pre-emption may require signs or signal heads which restrict specific movements when a train is present at the intersection. When a right turn is restricted during pre-emption the blank-out version of the R3-1 sign, as shown in Figure 10-2, should be installed at the intersection. When a left turn is restricted during pre-emption, a left turn signal head should be installed and programmed to show a solid red arrow during the pre-emption sequence. A blank-out version of the R3-2 sign, as shown in figure 10-2, may be installed in lieu of a left turn signal head, but this is not the preferred option. See Section 12.4 for more information on traffic signal pre-emption.

All blank-out signs must be shown on the Signal Design plan sheet. Sign cells should be shown and labeled at the installation location and summarized on same the plan sheet under the heading "Blank-out Signs." Blank-out signs should be centered over the turn lane(s) they control; one 24"x24" blank-out sign should be installed for single turn lanes and one 36" x 36" blank-out sign for multilane configurations.

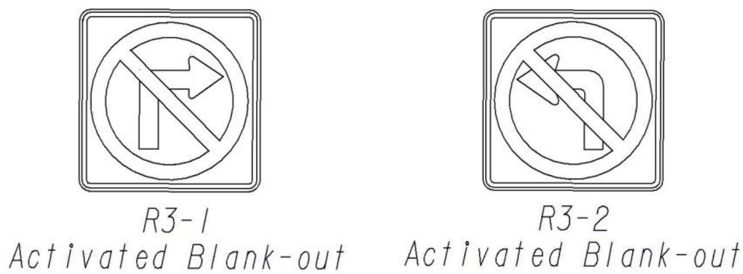


Figure 10-2: Blank-Out Sign Displays

10.2 Pedestrian Signs

The cell of any pedestrian sign that is used within a drawing should be placed under the heading "Pedestrian Signs" on the plan sheet. R10-3E (PEDESTRAIAN COUNTDOWN SIGN) signs should be provided to indicate the direction of crossing associated with each pushbutton. In special designs, such as Pedestrian Hybrid Beacons (PHB) and Rectangular Rapid Flashing Beacons (RRFB), refer to Example 8, 9, and 10 in Appendix A: Traffic Signal Plan Examples, and the MUTCD for sign type and locations. In instances where there is justification for not providing pedestrian accommodations, either a R9-3 or R5-10c sign (NO PEDESTRIANS) should be installed along with either a R9-3bPR or R9-3bPL sign (SUPPLEMENTAL ARROW) to designate the direction of the crossing. An example installation for these signs is shown below in Figure 10-3.

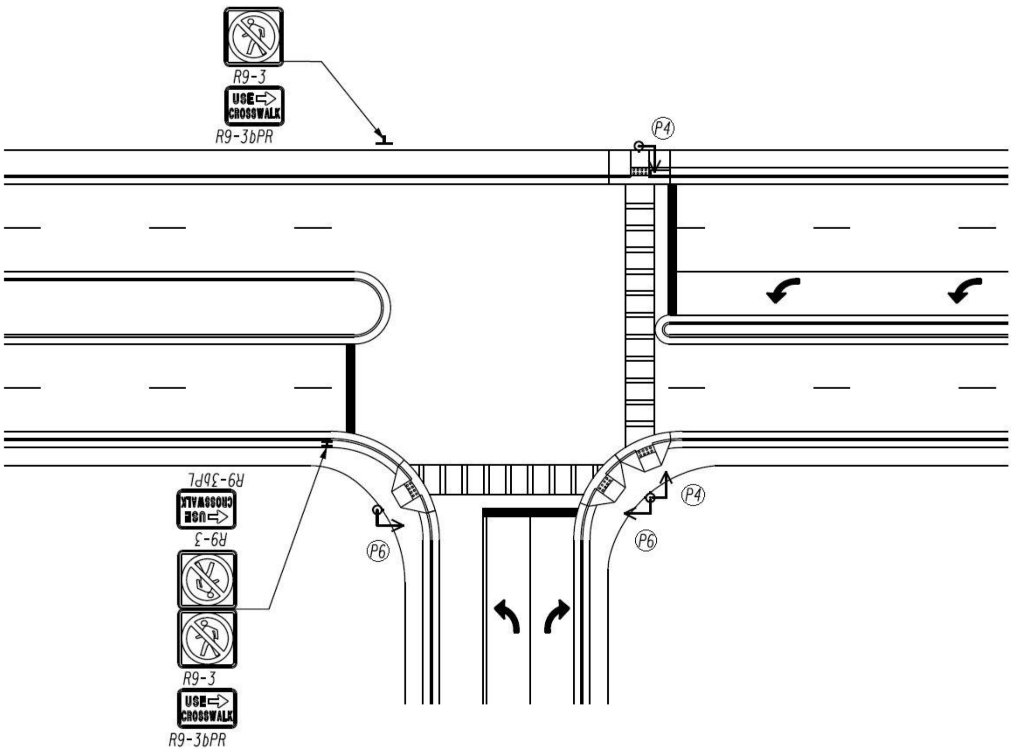


Figure 10-3: No Pedestrian Crossing Treatment

10.3 Overhead Street Name Signs

Overhead street name signs should be placed on mast arms or span wire within an intersection. If there are issues with visibility the overhead street name sign may be placed in a more optimal position closer to the roadway. In addition, two-sided overhead street name signs are allowed. Overhead street name signs should be mounted perpendicular to the opposing approach lanes. It should be noted that the use of illumined overhead street name signs are allowed but not included under GDOT standard installation. However, if an agency or local jurisdiction chooses to install an illuminated overhead street name signs they will be required to cover the associated expenses.

When the width of the sign does not affect the proper placement of signal heads, the sign should be mounted between the two signal heads with a preferred 1 foot spacing and 6 inches minimum spacing, between the sign and the signal back-plate. If the width of the sign cannot be accommodated between the two signal heads, the D3-1 sign should be placed to the right of the signal heads, on the strain pole, or mast arm pole. The cell of any overhead street name sign that is used within a drawing should be placed under a heading "Overhead Street Name Signs" on a plan sheet.

Overhead street name signs should only include the name of the roadway and an arrow indicating the direction of the roadway. For overhead street name signs at interstates or interstate ramps, the sign should include the interstate name, direction, and an arrow (e.g., I-75 South →). Overhead street name signs should be designated on a plan sheet as D3-1 and D3-1a as shown in the 2009 MUTCD Section 2D. The designation should also contain a sequentially increasing number to denote each street name sign placed at an intersection. For example, the street name sign for the major approach (the main street) should be designated as D3-1 (#1). The street name sign for the minor approach (the side street) should be D3-1 (#2).

D3-1 and D3-1a signs should use D series letters. Section 3.6 of the GDOT Signing and Marking Guidelines provides further guidance on the dimensions and layout of the overhead street names signs.

Section 11 PAVEMENT MARKINGS

Refer to the GDOT Signing and Marking Design Guidelines for information regarding the type and placement of pavement markings. Pavement markings should be shown on the Signing and Marking and Signal Design plan sheets. If there is no Signing and Marking plans sheets the pavement marking should be listed under a separate pay item. Existing pavement markings should be added to both major and minor street approaches on a plan sheet, as necessary. For signal upgrade projects in which the pavement markings will be replaced, the markings should be labeled as "remove and replace". It should be noted that dotted lane line extensions should be used anytime you have a dual turning movement (shown in Figure 11-1 below) or if there is a lane shift for lanes through a skewed intersection to guide vehicles through the intersection. The striping configuration is two-foot striping segment and six-foot gap. It should also be noted that the pavement marking "ONLY" should be used in dedicated turning lanes and stripped islands should not be included on a plan sheet.

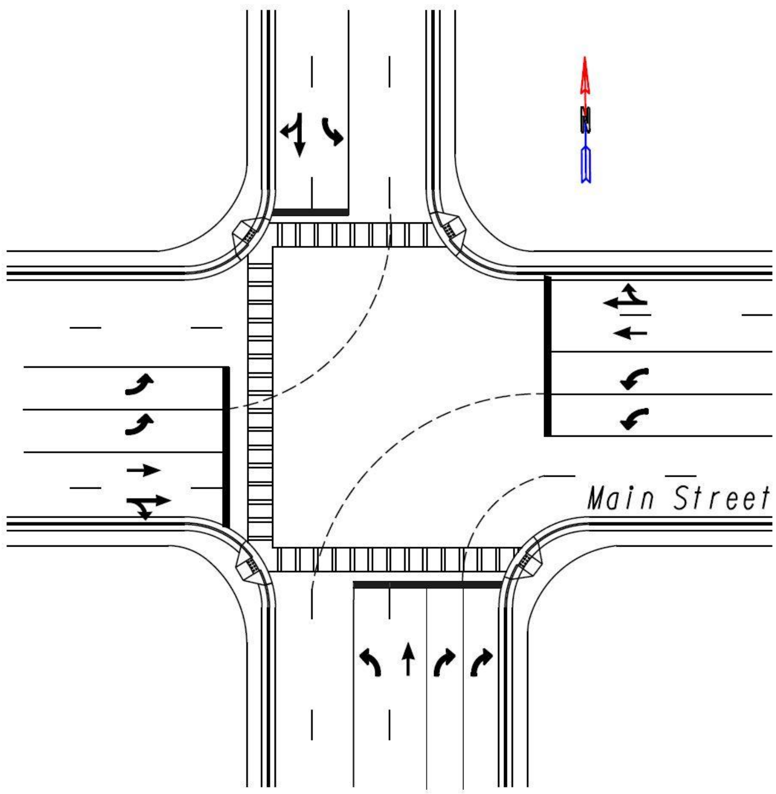


Figure 11-1: Typical Dotted Line Extension for Dual Left Movement.

Section 12 TRAFFIC SIGNAL PHASING

A phasing diagram should be placed on all signal plans. Phases 2 and 6 should be assigned to the through movements of the main street. Phasing should be assigned such that the arrow for phase 2 faces to the left in the phasing diagram, meaning phase 2 would typically serve the westbound or southbound approach. The orientation of phases should be consistent within a signal system. Generally, the numbering scheme for the through street phases should be oriented such that the through phases are ordered sequentially in a counterclockwise fashion based off the National Electrical Manufacturers Association (NEMA) standards. When left turn phases are added, the through and left turn phase numbers should sum to 7 for the main street approaches and 11 for the side street approaches. It should be noted that a circle should be placed around each pederstrain and approach phasing number. By placing a circle around the phasing number it allows for an unobstructed view of the phasing number. An example of the phasing number circled can be seen in Figure 12-2 below.

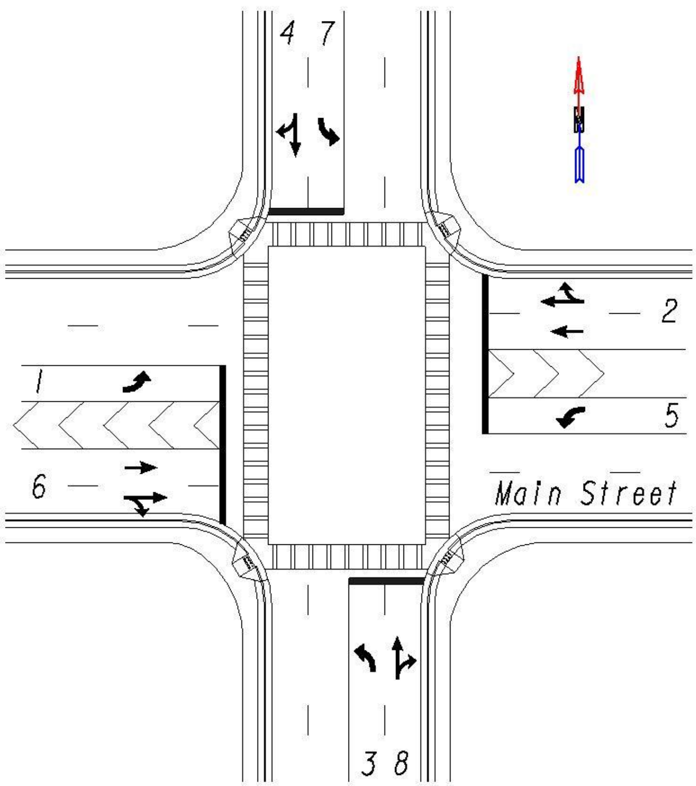


Figure 12-1: Example of Numbering Scheme for an Intersection.

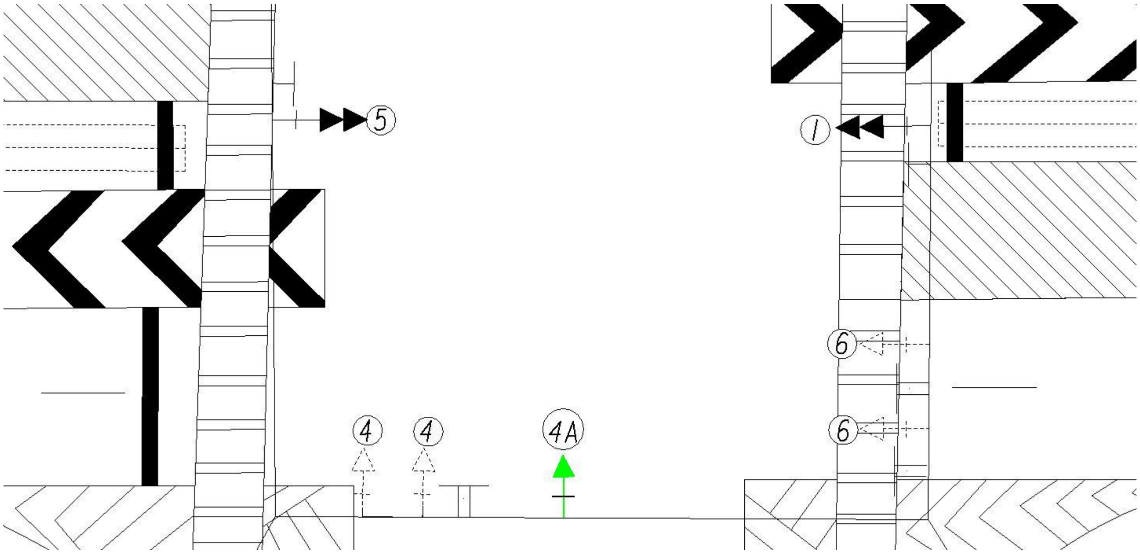


Figure 12-2: Example of Circles Around the Phasing Numbers.

The standard phase numbering system as illustrated in Figure 12-3 (A) should be used to designate signal phases at each intersection. It should be noted that the word “OMIT” should be placed in a phase that is not being used in the dual ring diagram as illustrated in Figure 12-3 (B)

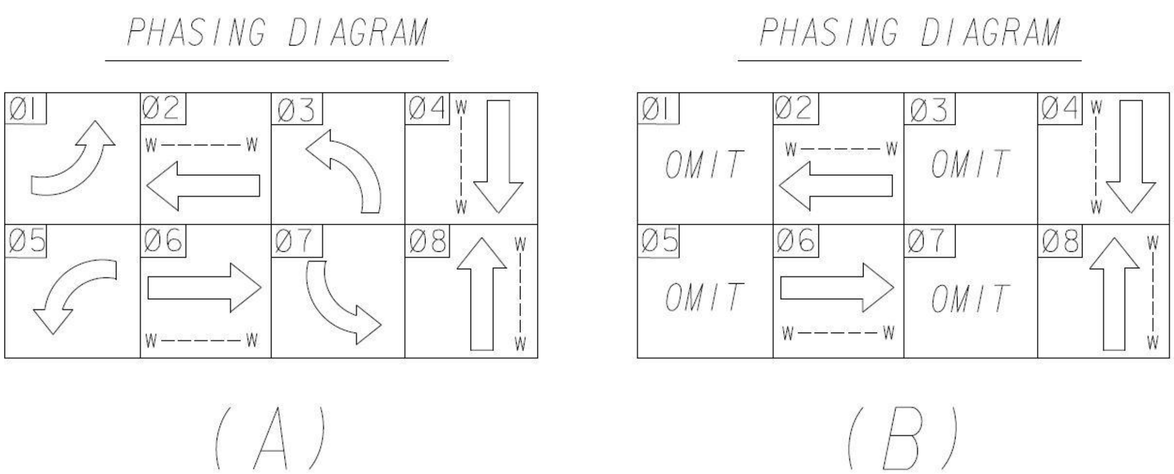


Figure 12-3: Typical Phasing Orientation: (A) Typical Phasing Diagram with No Phases Omitted. (B) Typical Phasing Diagram with Phases Omitted.

Special phasing note can be placed directly below the phasing diagram to provide more clarification (Lead/lag, OLA, etc.).

All intersections shall be set to an all red malfunction flash for each approach. Consideration for a yellow/red flash malfunction operation can be determined on a case by case basis using the departure sight distance triangles. Departure sight triangles for left and right turns on the minor approaches should be evaluated when an intersection is to be placed in a two-way flashing operation. Departure sight triangles should also be evaluated for any right turn that is allowed on a red indication. Additional information can be found in Chapter 9 of the AASHTO Green Book.

12.1 Left Turn Phasing

Under standard (concurrent) phasing, the odd phases (1, 3, 5, and 7) are reserved for left-turn movements. Left-turn phases should be used only when a left-turn lane exists and sufficient justification for the left-turn phase exists (see GDOT Policy 6785-2 for justification for left-turn phasing). If the left-turn phase is not used, the word "OMIT" should be shown in that phase in the phasing diagram.

Four-section flashing yellow left turn arrow (FYA) heads should be used where protected/permissive left turn operation is warranted, as defined in the GDOT Policy 6785-2. A three-section bi-modal FYA signal head may also be used if approved by the State Traffic Engineer; bi-modal FYA signal heads combine the solid yellow and flashing yellow left turn arrows in the same section. However, GDOT prefers the use of four-section FYA heads over bi-modal FYA heads.

Lead/lag phasing can be used for protected/permissive left turns (PPLT) when volume thresholds, geometry of intersection, or jurisdiction requirements warrant. Lead/lag phasing for protected/permissive left turns should only be controlled by FYA heads. Lead/lag phasing can also be used for protected only left turns, when a FYA is provided, or intersections without an opposing left turn movement. An example of a lagging phase orientation can be seen in Figure 12-4 below.

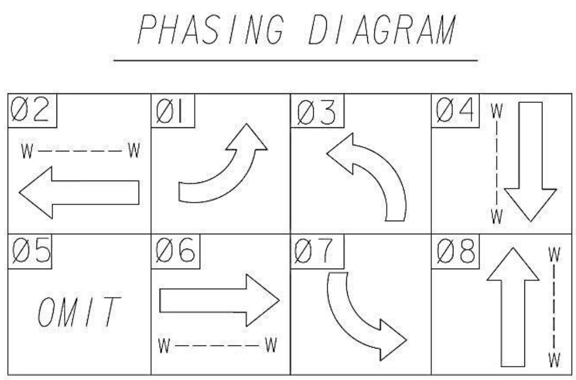


Figure 12-4: Lagging Phase Orientation

12.2 Right Turn Overlap

Right turn movements operating in exclusive lanes can be assigned to any phase that is not conflicting. GDOT recommends the use of either a 5 section or 4 section FYA signal head (with right facing arrows) when a right turn overlap is used. If a right turn overlap is used, an overlap label should be shown in the corresponding parent phase in the phasing diagram. The overlap label should contain a sequentially increasing letter to denote each overlap placed at an intersection. For example, the first overlap should be OLA and the second should be OLB, etc. An additional note indicating what phases go with an overlap should be inserted beneath a phasing diagram (e.g. OLA = Ø3 + Ø6). There are two ways for a right turn overlap to be displayed in a phasing diagram, hard wired (solid arrow) or true overlaps (dashed arrow) (shown in Figure 12-5 below).

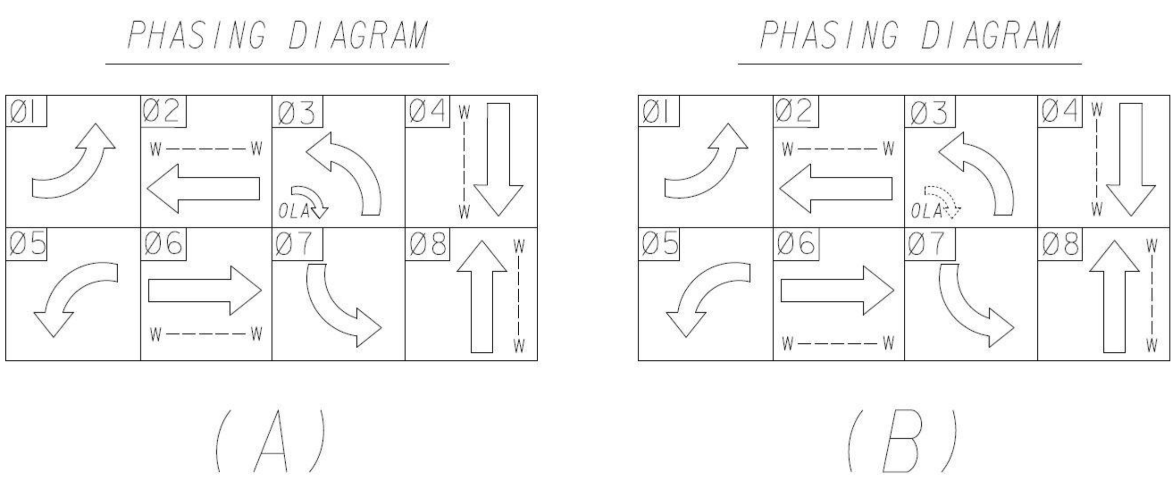


Figure 12-5: Wired Right Turn Overlap Orientation: (A) Hard Wired and (B) True Overlap.

12.3 Split Phasing

Depending on field conditions (lane geometry, volumes, etc.), split phasing may be required. Split phasing should be used only when concurrent phasing is deemed unacceptable. Head arrangement for split phasing is typically different from that used for concurrent phasing (see Example 5 in Appendix A: Traffic Signal Plan Examples for an example of split-phased head placement). Phase 3 and Phase 4 are typically used for the split phasing of side streets, as shown in Figure 12-6. Phases 3 and 4 should be assigned based on the proposed phasing sequence for the intersection; side street phases should not be assigned by directional or counter-clockwise methods typically used in concurrent phasing.

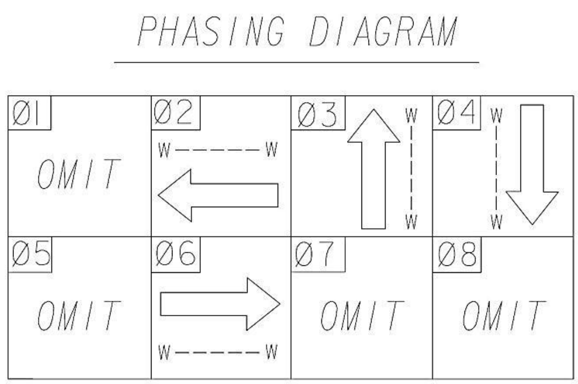


Figure 12-6: Split Phasing Orientation

12.4 Pre-emption

Pre-emption is typically used to clear traffic at a signalized intersection in order to allow passage of a high priority vehicle. Common pre-emption applications include railroad pre-emption, emergency vehicle pre-emption, and transit pre-emption. Consideration should be given in order to ensure that phasing and controller programming prevent the possibility of a left turn trap when entering a pre-emption sequence. To ensure a left turn trap is not created, the pre-emption sequence should always begin with the mainline phases indicating red.

12.4.1 Railroad Pre-emption

When signalized intersections are located within 200 feet of railroad at-grade crossings, consideration should be given to establishing pre-empt operation (see Section 8C.09 of the 2009 MUTCD). Furthermore, the FHWA *Railroad Highway Grade Crossing Handbook* instructs that, any traffic signals in close proximity to highway-railroad grade crossings should include provisions for railroad preemption, to allow for clearing any queued vehicles off the grade crossing prior to the arrival of a train.

When considering the use of pre-empted operation near railroad at-grade crossings, consider the following factors:

- Frequency and duration of trains
- Volume of vehicular traffic at the crossing
- Distance to the crossing and the frequency of vehicular queues at the crossing
- The complexity of the signal phasing and whether opportunities exist to serve certain movements effectively during the period when trains are using the crossing
- The spacing of traffic signals with short block lengths

When pre-emption is used it must be reflected in the phasing diagram for that intersection. Figure 12-7 below is an example of an intersection signal phasing diagram with pre-emption.

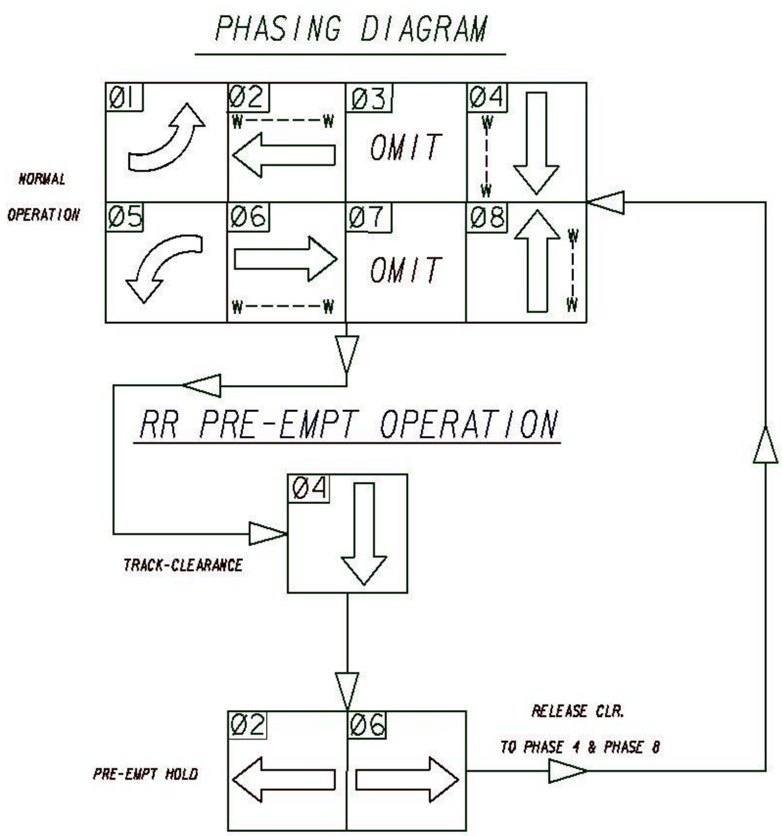


Figure 12-7: Sample Pre-emption Phasing Diagram

According to the FHWA *Railroad Highway Grade Crossing Handbook*, "*At a signalized intersection located within 60 meters (200 feet) of a highway-rail grade crossing, measured from the edge of the track to the edge of the roadway, where the intersection traffic control signals are preempted by the approach of a train, all existing turning movements toward the highway-rail grade crossing should be prohibited during the signal preemption sequences*." Blank-out signs or dedicated signal heads for turning movements should be used in coordination with railroad preemption to prohibit permissive turn movements across railroad tracks while the signal is operating in pre-emption. When a left turn is restricted during pre-emption, a left turn signal head should be installed and programmed to show a solid red arrow during the pre-emption sequence. A blank-out version of the R3-2 sign, as shown in figure 10-2, may be installed in lieu of a left turn signal head, but this is not the preferred option.

Conduit and pull boxes at the base of the railroad cabinet should be shown on the plan sets. Cabinet GRS conduit should be used for the lead-in cable for railroad preemption. There are instances in which the railroad company will install a junction box at the edge of its right-of-way with an output from the train detection device. Battery backups should be used with all railroad preemption intersections. See Section 6 Battery Backup for other battery backup applications. When designing for any traffic signal with railroad pre-empt operations, designers should coordinate with the railroad section within GDOT's Office of Utilities.

12.4.2 Emergency Vehicle Pre-emption

Pre-emption may also be used in assisting emergency vehicles entering and exiting driveways (e.g., near fire stations) and through areas likely to be blocked by normal traffic (e.g., on one-way streets).

When considering the use of preempted operation consider the following factors:

- Frequency of emergency vehicle operations Inability of emergency vehicles to safely enter and move in the normal traffic stream
- The existence of consistent, predictable emergency vehicle routes
- Potential for disruption of normal traffic flow

Section 13 VEHICULAR SIGNALS

Twelve-inch light emitting diode (LED) vehicular signal heads with louvered back plates with two-inch type IX retro-reflective tape along the perimeter should be installed as required for all vehicular signal head installations. See Section 925 of the GDOT Standard Specifications for further information on traffic signal head specifications. The configuration, color, placement, and other details of signal heads should be clearly distinguished on the traffic signal plan sheet.

13.1 Signal Placement

One overhead signal head per through lane should be provided for each approach of an intersection, and at least two red ball indications are required per approach, if a through movement is allowed. Signal heads for through movements should be placed such that they guide vehicles into the appropriate receiving lane by locating the head over the desired path of the vehicle, which may not be directly in front of the approach lane. The minimum distance between through signal heads is 8 feet. Signal heads should be located within a 20-degree cone of vision as specified in the MUTCD. The height of the signal head should meet minimum clearance requirements of 17 feet when mounted on a mast arm or span wire. The signal heads longitudinal position should be at least 40 feet from the stop bar but not greater than 180 feet. If signal heads cannot be placed within this longitudinal range, supplemental signal heads will be required. Supplemental heads may also be necessary if there is a skew or curvature to the roadway. Pedestrian phases should be considered when designing signal heads in order to prevent conflicts between vehicles and pedestrians.

Refer to Section 4D of the MUTCD for the positioning of signal heads and type of signal heads to be used for different lane configurations. Appendix B: Vehicular Signal Head Placement Examples shows examples of signal head placement according to GDOT standards and should also be used for additional insight on signal head placement. The examples also provide guidelines for signal display and turn indication. The designer should keep in mind that these are examples and that engineering judgment should be used in each intersection design.

13.2 Signal Placement for Left-Turn Lanes

The type of signal head and positioning required for left turn lanes depends upon the number of turn lanes and the turn phase type at a given intersection approach. A dedicated signal head may not be necessary for a permissive only left turn, assuming the through movement signal heads are within the required cone of sight. If a left turn signal head is deemed necessary, a single left turn lane with a permissive only phase should be controlled with a three-section FYA signal head (non-bimodal) centered in front of the turn lane. A single left turn lane with a protected/permissive phase should be controlled with a four-section FYA signal head centered in front of the turn lane. A single left turn lane with a protected only phase should be controlled with a four-section T-shaped left turn arrows signal head centered in front of the left turn lane. Multiple lane left turn movements should always use a protected only phase and should be controlled with multiple three-section left turn arrows signal heads, one centered over each turn lane. When designing signal plans with lanes designated for both through and left turn traffic, contact the State Signal Engineer for information on the recommended signal head arrangement. See Appendix B: Vehicular Signal Head Placement Examples for design guidelines.

13.3 Non-typical Signal Heads

All supplemental heads should use a 3-section signal head. Typically, supplemental signal heads are supported by the signal span wire either on the lead from the signal pole to the bull ring or on the bull ring itself. Supplemental signal heads may be mounted on pedestals only when necessary and installed such that the lowest part of the head is a minimum of twelve feet above the ground. Pedestal mounted signal heads should only be used for supplemental purposes.

Supplemental signal heads shall be installed if typical signal head arrangement does not allow for the minimum sight distance visibility as specified in Section 4D of the MUTCD. Furthermore, supplemental signal heads may provide a benefit, even for intersections that meet minimum sight distance visibility requirements; engineering judgment should be applied at all intersections when determining the need for supplemental heads. The number and arrangement of supplemental signal heads are subject to the approval of the State Traffic Engineer. Supplemental signal heads should be labeled with the phase number and an "S" (for example 4S or 2S) on the signal plan sheets. The supplemental head label should be placed next to the signal head location cells and underneath the signal head detail cells.

In some scenarios, if approved by the State Traffic Engineer, the use of bimodal signal heads may be considered due to operational, clearance, and other considerations. A three section bimodal FYA signal head displays a solid red arrow in the top section, a solid yellow arrow in the middle section, and a solid green/flashing yellow arrow in the bottom section. A three-section bimodal FYA signal head may be considered for protected/permissive left turns.

13.4 Signal Head Location Cells

There are three basic cells used to display the installation location of vehicular signal heads on a plan sheet, the three section signal head (A, B, C, D), the vertical four section signal head (E), and a variation of a four and five section signal head (F). Examples of the cells for these signal heads can be found in Figure 13-1 below. A dashed line type in grayscale should be used for existing signal heads and a solid line type with a filled in arrow head should be used for proposed signal heads. Signal head back plates are indicated by a line shown behind the triangle shape, while shifted signal heads are indicated by a line shown in front of the triangle shape. The location cells, and the corresponding phase number, for signal heads should be shown at their installation location within the drawing of an intersection.

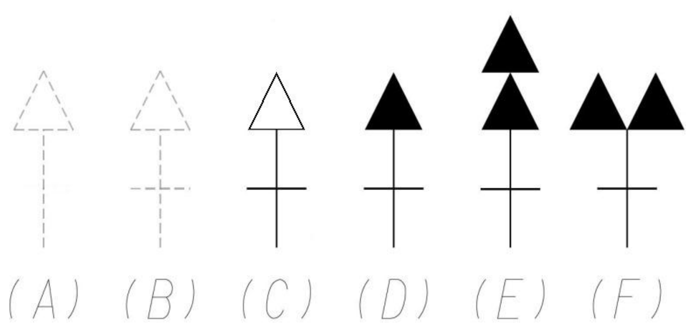


Figure 13-1: Typical Signal Head Cells: (A) Existing 3 Section Signal Head Without Back Plate, (B) Existing 3 Section Signal Head with back plate (C) Shifted 3 Section Signal Head, (D) Proposed 3 Section Signal Head, (E) Proposed Vertical 4 Section Signal Head, (F) Proposed T-Shaped/5-Section Signal Head

13.5 Signal Head Detail Cells

The signal head detail cells should be shown on the plan sheet under the heading "LED Signal Heads with Retro-Reflective Back Plates". The cells should clearly indicate the 12" dimension of each section of the signal head, and no dots should be shown within the face of the signal. The cells should also indicate the color/function of each section of the signal head (R = red, Y yellow, G = green, FY = flashing yellow, SY = solid yellow). Each signal head cell should list the corresponding phase(s) underneath the head. All phases should have at least one signal head detail cell; if multiple signal heads are needed for a single phase, a lettering scheme should be used to distinguish different heads. Examples of signal head detail cells for various approach scenarios can be found in Figure 13-2 below.

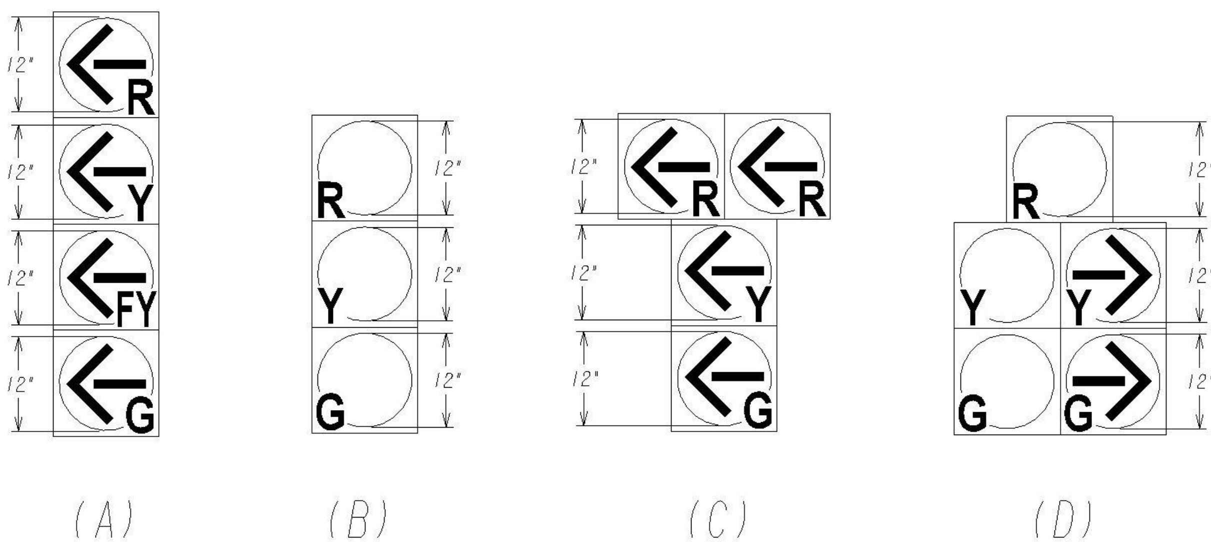


Figure 13-2: Examples of Typical Signal Head Detail Cells: (A) 4 Section FYA Signal Head, (B). Standard 3 Section Head, (C) Protected Only "T-Shaped" Signal Head, (D). 5 Section Signal Head for Right Turn Overlap

Additional examples of signal head detail cells can be found in Appendix D: Examples of Signal Head Detail Cells. Special signal faces, such as electronically steerable LED's, may be used (MUTCD, Section 4D.12).

Section 14 PEDESTRIAN SIGNAL HEADS

Eighteen-inch LED pedestrian countdown signal heads (with the corresponding pedestrian phase number) should be placed at all approaches with a crosswalk within an intersection drawing. See Section 925 of the GDOT Standard Specifications for further information on pedestrian signal head specifications. The detail cell for an eighteen-inch LED pedestrian countdown signal heads must be shown on the plan sheet under the “LED Signal Head” label. Additionally, the pedestrian cell for the plan view should be drawn as an arrow to provide a clear representation of the direction of the pedestrian signal head. An example of the new pedestrian head signal head cell can be seen in Figure 14-1 below.

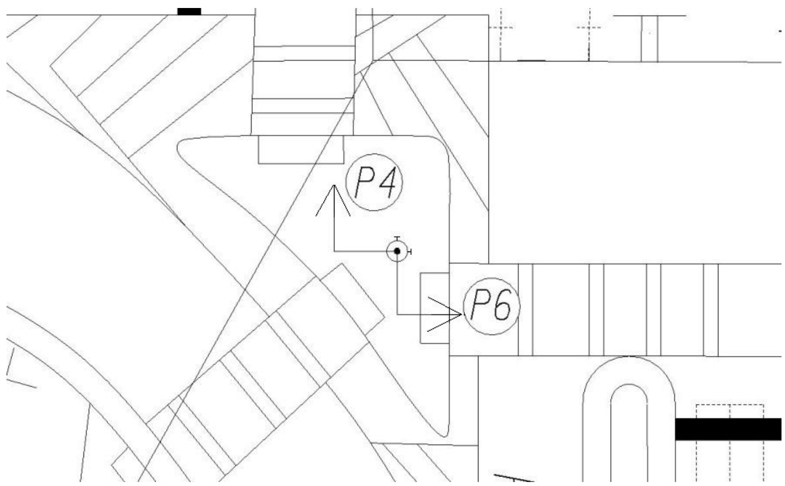


Figure 14-1: Example of New Pedestrian Signal Head Cell.

Pedestrian signal heads may be installed on utility poles, span wire poles, mast arm poles, push button poles, or dangled from a span wire bull-ring or a mast arm. Pedestrian signal heads shall be mounted with the bottom of the signal housing, including brackets, not less than 7 feet or more than 10 feet above sidewalk level, and shall be positioned and adjusted to provide maximum visibility at the beginning of the controlled crosswalk. The pedestrian signal head must be visible through the entire length of the crosswalk. See Section 4E of the MUTCD for further information on placement of pedestrian signal heads. If the crosswalk runs through a raised median and the pedestrian signal heads cannot be seen for the entire length of the crossing, supplemental pedestrian signal heads should be placed in the raised median facing each direction. Refer to Section 5 PEDESTRIAN INFRASTRUCTURE for information regarding the placement of the pedestrian signal head.

Section 15 VEHICLE DETECTION

Actuated and semi-actuated traffic signals require some form of vehicle detection to activate a call to the signal controller. Section 937 of the GDOT Standard Specifications provides details regarding the various forms of vehicle detection available for signalized intersections.

All detectors should be wired to unique detector channels, even if they are used for detecting vehicles for the same phase or approach. All detectors/detection zones should be labeled with "L" for inductive loops, "M" magnetometer, "R" for radar, or "V" for virtual, as well as the corresponding phase number; detectors/zones for the same phase should be distinguished as "A", "B", "C", etc. with "A" being the left most lane of an approach. For example, "L5" would be for the loop on phase 5 or "V2B" would be the video detection zone for the second lane on phase 2.

15.1 Detector Modes

Vehicle detectors may be designed for multiple operation modes which serve different functions. The two most common detector modes are presence (stop bar) mode and pulse (setback) mode. Section 937 of the GDOT Standard Specifications provides further details on vehicle detector modes.

Presence detectors are typically installed for left turn and side street phases. All presence detectors should be shown as 6-foot by 40-foot rectangular zones with the front of the zone being two (2) feet past the stop bar.

Setback detectors are typically used for the mainline. If the minor street serves similar traffic volumes or has a design speed exceeding 35 mph, setback detectors should also be installed on these approaches. All setback passage detectors should be shown as a 6-foot by 6-foot square zone with a label specifying the distance from the front of the detection zone to the stop bar. Setback passage detectors must be placed at a specific distance in order for the controller to operate the intersection efficiently. Table 15-1 shows the minimum distance from the stop bar to the front of the setback passage detector for different design speeds. If setback passage detectors cannot be placed at the exact recommended distance due to an obstruction, they should be placed farther from rather than closer to the stop bar.

Table 15-1: Setback Detector Distance

Posted Speed Limit, miles per hour	Minimum Setback Distance, feet
35	260
40	300
45	330
50	370
55	410
60	440
65	480

It should be noted that atypical detection may be installed in order to provide additional signal timing benefits for an intersection. Presence detection may be installed for the mainline through phases in order to facilitate automated turning movement counts, performance metrics, adaptive signal timing, and other beneficial signal timing features. Setback detection may be installed for the side street for intersections with high vehicle speeds, dual coordination, heavy traffic volumes, etc.

15.2 Methods of Detection

All forms of vehicle detection present their own advantages and disadvantages; engineering judgment is required when designing for vehicle detection. The most desirable method of vehicle detection is the use of inductive loops. If the use of loops is infeasible (e.g. bridge deck) or impractical (e.g. poor pavement conditions), the use of alternative vehicle detection should be considered. Wireless magnetometers, radar, and microwave, etc. based detection may all be considered when determining an alternative method of vehicle detection. Video detection is the least desirable form of vehicle detection, but may also be considered for use at signalized intersections. Figure 15-1, shown below, provides details on how zones for different methods of detection should be shown on traffic signal plans.

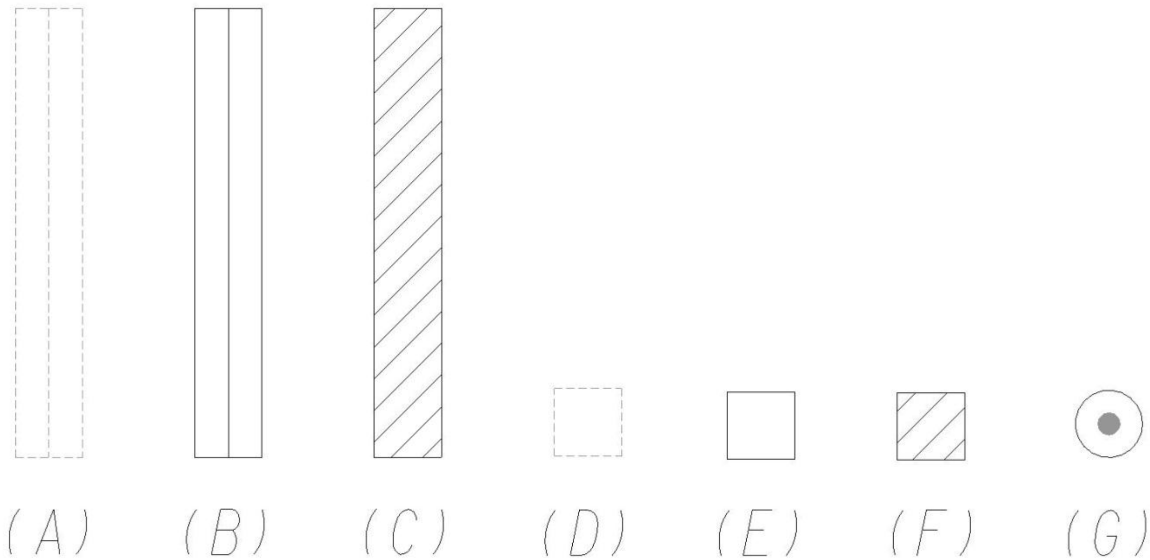


Figure 15-1: Typical Detector/zones Cell Examples: (A) Existing Inductive Loop Detector, (B) Proposed Inductive Loop Detector, (C) Proposed Virtual Detection Zone, (D) Existing Setback Inductive Loop, (E) Proposed Setback Inductive Loop, (F) Proposed Setback Virtual Detection Zone, and (G) Proposed Magnetometer Sensor/Detection Zone.

15.2.1 Inductive Loop Detectors

Inductive loop detectors are constructed by embedding cable into saw cuts made in the road surface. Construction Detail TS 01 and Section 937 of the GDOT Standard Specifications provide further details on inductive loop detectors. See Example 1 in Appendix A: Traffic Signal Plan Examples for further details on how inductive loops should be shown on traffic signal plans.

Typically, a 6-foot by 40-foot loop installation requires 344 feet of loop wire, 132 feet of saw cuts, plus twice the distance to the edge of pavement for each quantity. Typically, a 6-foot by 6-foot loop installation requires 108 feet of loop wire, 32 feet of saw cuts, plus twice the distance to the edge of pavement for each quantity. Each loop lead-in should be shown as having its own saw cut from the loop to the edge of pavement. All loop wire should be shown coming from the corner of the loop. When possible, saw cuts for loop wire should be located to avoid areas susceptible to damage by vehicles, such as in the corner radius.

After reaching the first pull box, loop lead-ins should be shown installed underground and run via conduit and pull boxes to the cabinet. This may require the cutting of paved surface or boring under driveway; however, the designer may also consider aerial methods to run the loop lead-in to the cabinet via utility and signal poles. All exposed conduit should be constructed of 2-inch GRS. All loops should be wired to unique detector channels, even though they may be on the same approach and input into the same phase. All existing and purposed loops should be called out on a plan sheet.

15.2.2 Wireless Magnetometer Detection

Magnetometer vehicle detectors are small sensors embedded in holes drilled in the road surface. The installation for this method of detection consists of multiple components. Care should be given to ensuring effective and efficient placement of the access point(s) and wireless repeater(s).

A single wireless magnetometer sensor provides a 6-foot by 6-foot detection zone, ideal for setback detection. When designing for stop bar detection, multiple wireless magnetometer sensors can be used in order to mimic a 6-foot by 40-foot detection zone. At least one digital radio access point, typically installed on a pole close to the cabinet, is required per intersection and has the capability of detecting magnetometers within 100-150 feet. Wireless repeaters, typically installed on a pole farther from the cabinet, may be required in order relay information from magnetometers to the access point. Wireless repeaters should be called out on a plan sheet to ensure the proper installation location. The direction of the wireless repeater should also be indicated on a plan sheet. Each installation requires cat 5e cable running from the digital radio to the cabinet, as well as an isolator and detector card(s) installed at the cabinet. All existing and purposed wireless magnetometers should be called out on a plan sheet.

15.2.3 Microwave/Radar Detection

There are multiple methods of radar/microwave based vehicle detection that consist of mounted detector units which use microwave or radar technology and programmed virtual detection zones. Wireless detection installations include multiple components;

care should be taken when determining the necessary components and their locations. Section 937 of the GDOT Standard Specifications provides further details on microwave/radar detection. Detection zones should be shown as rectangular zones with diagonal hatching as seen in Figure 15-1(C). All existing and purposed radar units should be called out on a plan sheet. The direction of the radar units should be indicated on the plan sheet.

15.2.4 Intersection Video Detection Systems (IVDS)

IVDS assemblies consist of mounted cameras and programmed virtual detection zones. Section 937 of the GDOT Standard Specifications provides further details on IVDS detection. Detection zones should be shown as rectangular zones with hatching as seen in Figure 15-1(C). See Example 5 in Appendix A: Traffic Signal Plan Examples for further details on how IVDS assembly installations should be shown on traffic signal plans.

IVDS assemblies include multiple components; care should be taken in determining the necessary components and their locations. The installation location of cameras is critical to the design of an IVDS system. Typically, cameras are located on the side of the intersection farthest from the programmed detection zone. If mast arms are present at an intersection, cameras should be mounted directly over receiving lanes at the proper mounting height. If mast arms are not present, cameras should be located to give the most head on view of the receiving lane. All existing and purposed cameras should be called out on a plan sheet. The direction of the camera should be indicated on the plan sheet.

Appendix A: Traffic Signal Plan Examples

List of Examples:

A-2: SR 74 @ SR 54

- Flashing Yellow Arrow (FYA)
- Protected only left turn
- Span wire
- Right turn overlap (5-section)
- Loop Detection
- Overlap Phase

A-3: SR 92 @ Bowen Road Existing Plan

- Protected only left turn
- FYA
- Span wire
- Loop Detection

A-4: SR 92 @ Bowen Road Proposed Plan

- Protected only left turn
- 5-section signal head
- Existing Plan Example
- Span wire
- Loop Detection

A-5: SR 92 @ Bent Grass Road

- Supplemental Heads
- Mast Arms
- Radar Detection

A-6: SR 85 @ Pointe South Parkway

- FYA
- Mast arms
- IVDS detection
- Split Phasing
- Protected only left turn

A-7: SR 204 Spur @ Harry S Truman NB Ramp

- Leg without pedestrian crossing
- Mast arms
- Loop Detection

A-8: SR 27/US 341 @ F Street

- Rectangular Rapid Flashing Beacon (RRFB)

A-9: SR 42 @ Briarcliff Place/St. Louis Place Midblock Crossing

- Single Stage Pedestrian Hybrid Beacon (PHB)

A-10: SR 42 @ Briarcliff Place/St. Louis Place Midblock Crossing

- Dual Stage PHB

A-11: SR 74 @ Georgian Park

- Magnetometer Detection

*Design features listed on examples are intended to benefit the reader but are not required to be included on traffic signal plan sets.


LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
PHASING DIAGRAM
PEDESTRIAN SIGNS
R10-3E(L) (9"x15")
R10-3E(R) (9"x15")
OVERHEAD STREET NAME SIGNS
Joel Cowan Pkwy
D3-1*1
Floy Farr Pkwy
D3-1*2
REGULATORY SIGNS
R1-2
R10-5A
R10-7
R560-5
SR 54
SPEED LIMIT = 45 MPH
SR 74
SPEED LIMIT = 40 MPH
EXISTING 6'X40' PRESENSE DETECTION (TYP)
INSTALL NEW 3-SECTION SIGNAL HEAD (TYP)
REALIGN EXISTING OVERHEAD STREETNAME SIGN (D3-1*2)
REALIGN EXISTING 3-SECTION SIGNAL HEAD (TYP)
EXISTING R1-2 SIGN
REMOVE EXISTING R560-5 SIGN
REMOVE EXISTING R1-2 SIGN
REALIGN EXISTING R10-7 SIGN (TYP)
REALIGN EXISTING OVERHEAD STREETNAME SIGN (D3-1*1)
REALIGN EXISTING 5-SECTION SIGNAL HEAD (TYP)
REMOVE EXISTING R1-2 SIGN
REMOVE EXISTING R560-5 SIGN
EXISTING R560-5 SIGN
REALIGN EXISTING OVERHEAD STREETNAME SIGN (D3-1*1)
INSTALL NEW R10-5A SIGN (TYP)
INSTALL NEW 4-SECTION FLASHING YELLOW SIGNAL HEAD AND 7 CONDUCTOR CABLE (TYP)
EXISTING R1-2 SIGN
EXISTING 6'X6' LOOPS 330' FROM STOPBAR (TYP)
REMOVE EXISTING R560-5 SIGN
REMOVE EXISTING R1-2 SIGN
REALIGN EXISTING OVERHEAD STREETNAME SIGN (D3-1*2)
INSTALL AUXILLARY OUTPUT FILE
* DESIGN FEATURES
- SPAN WIRE
- 5 SECTION SIGNAL HEAD
- LOOP DETECTION
- OVERLAP PHASE
* DESIGN FEATURES
- FLASHING YELLOW ARROW (FYA)
- PROTECTED ONLY LEFT
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
REVISION DATES
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
SIGNAL PLANS
SR 74 @ SR 54
DRAWING No. 27-01

LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
1, 5
2, 4, 6, 8
7/4, 3/8
P2, P4, P6, P8
18"
PHASING DIAGRAM
Ø1
Ø2
Ø3
Ø4
Ø5
Ø6
Ø7
Ø8
*DESIGN FEATURES
- PROTECTED ONLY LEFT
- 5-SECTION HEAD
- EXISTING PLAN EXAMPLE
*DESIGN FEATURES
- SPAN WIRE
- LOOP DETECTION
EXISTING 6'X6' SETBACK DETECTION: 330' FROM STOP BAR (TYP)
EXISTING 332 CABINET W/2070 LX CONTROLLER
EXISTING 6'X40' PRESENCE DETECTION (TYP)
EXISTING STRAIN POLE (TYP)
HWY 92/WOODSTOCK RD SPEED LIMIT = 45 MPH
HWY 92/WOODSTOCK RD SPEED LIMIT = 45 MPH
MOUNTAIN PARK RD SPEED LIMIT = 35 MPH
BOWEN RD SPEED LIMIT = 35 MPH
REGULATORY SIGNS
LEFT TURN YIELD ON GREEN
R10-12
YIELD
R1-2
RIGHT LANE MUST TURN RIGHT
R3-7R
LEFT TURN SIGNAL
R10-10L
STATE LAW STOP FOR PEDESTRIAN IN CROSSWALK
R560-5
OVERHEAD STREET NAME SIGNS
Mountain Park Rd
D3-1(*4)
Bowen Rd
D3-1(*3)
Woodstock Rd
D3-1(*1)
Mountain Park Rd
D3-1(*2)
Bowen Rd
D3-1(*5)
SCALE IN FEET
0
30
60
120
GEORGIA DEPARTMENT OF TRANSPORTATION
REVISION DATES
STATE OF GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
SIGNAL PLANS
SR 92 (WOODSTOCK RD)@ BOWEN RD/ MOUNTAIN PARK RD
STATE GA
COUNTY FULTON
MAINTAINING AGENCY CITY OF ROSWELL
GDOT INTERSECTION NUMBER 0007567
Design Examples.dgn

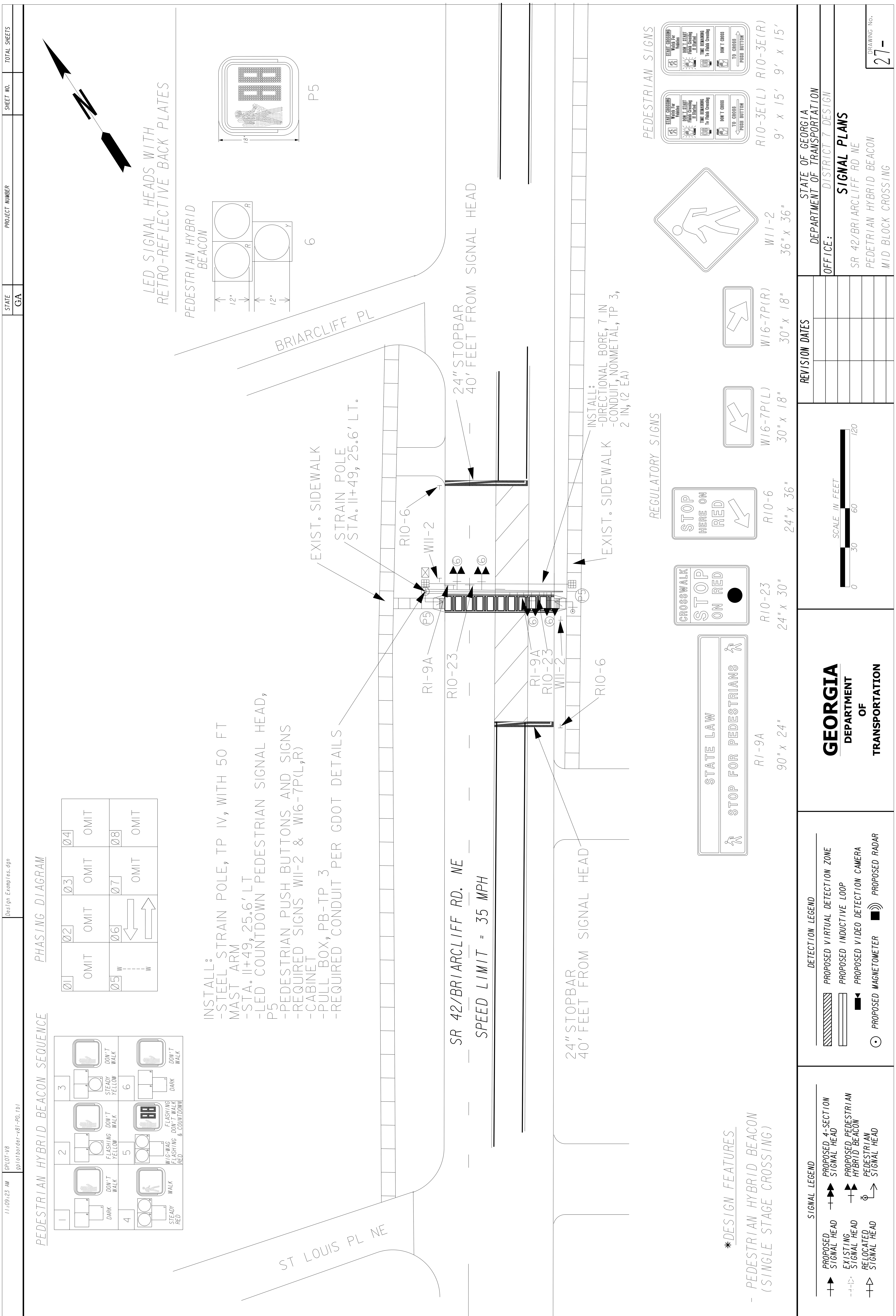

STATE GA
COUNTY FULTON
MAINTAINING AGENCY FULTON COUNTY
GDOT INTERSECTION NUMBER 0007537
LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
2, 4, 6, 8
1, 5
3, 7
P2, P4, P6, P8
PEDESTRIAN SIGNS
R10-3E(L) (9"x15")
R10-3E(R) (9"x15")
OVERHEAD STREET NAME SIGNS
Mountain Park Rd
Bowen Rd
Woodstock Rd
D3-1(#1)
D3-1(#2)
D3-1(#3)
D3-1(#4)
D3-1(#5)
REGULATORY SIGNS
R10-12
R1-2
R3-7R
R10-10L
R560-5
PHASING DIAGRAM
Ø1 Ø2 Ø3 Ø4
Ø5 Ø6 Ø7 Ø8
SR 92/WOODSTOCK RD
SPEED LIMIT = 45 MPH
MOUNTAIN PARK RD
SPEED LIMIT = 35 MPH
BOWEN RD
SPEED LIMIT = 35 MPH
EXISTING 6'X6' SETBACK DETECTION; 330' FROM STOP BAR (TYP)
EXISTING 332 CABINET W/2070 LX CONTROLLER POWER DISCONNECT AND METER BASE ASSEMBLY
REALIGN EXISTING SIGNAL HEAD
EXISTING 6'X40' PRESENCE DETECTION (TYP)
REMOVE TWO 3-SECTION LEFT TURN ARROWS HEADS
INSTALL T-SHAPED LEFT TURN ARROWS HEAD (TYP)
INSTALL R10-5A SIGN
EXISTING STRAIN POLES (TYP)
REALIGN D3-1(#1)
REMOVE 5-SECTION SIGNAL HEAD
INSTALL FYA SIGNAL HEAD (TYP)
INSTALL NEW 3-SECTION SIGNAL HEAD (TYP)
*DESIGN FEATURES
- T-SHAPED SIGNAL HEAD (PROTECTED LEFT ONLY)
- FLASHING YELLOW ARROW (FYA)
- SPAN WIRE
- LOOP DETECTION
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
0 30 60 120
REVISION DATES
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
SIGNAL PLANS
SR 92 (WOODSTOCK RD) @ BOWEN RD/ MOUNTAIN PARK RD

STATE GA
COUNTY FULTON
MAINTAINING AGENCY CITY OF ROSWELL
GDOT INTERSECTION NUMBER 0014817
LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
R Y G
6S
2, 4, 6, 8
R Y FY G
1,5
18"
12"
P2, P4, P6, P8
OVERHEAD STREET NAME SIGNS
Crossville Rd
D3-1 #1
Bent Grass Rd
D3-1 #2
Bent Grass Rd
D3-1 #3
REGULATORY SIGNS
YIELD
R1-2
R10-5A
PEDESTRIAN SIGNS
R10-3E(L) 9"x15"
R10-3E(R) 9"x15"
SETBACK DETECTION ZONES 330' FROM STOP BAR (TYP)
SR 92/CROSSVILLE RD SPEED LIMIT = 45 MPH
EXISTING 6'X40 PRESENCE DETECTION (TYP)
INSTALL STOPBAR RADAR DETECTION UNIT (R4)
REMOVE (2) 3-SECTION AND INSTALL 4-SECTION FYA SIGNAL HEAD
INSTALL: R10-5A SIGN
INSTALL ADVANCE RADAR DETECTION UNIT (R2)
INSTALL STOPBAR RADAR DETECTION UNIT (R5)
BENT GRASS RD SPEED LIMIT = 25 MPH
INSTALL RADAR DETECTION CABINET ASSEMBLY IN EXISTING 332 CABINET W/2070LX CONTROLLER
INSTALL STOPBAR RADAR DETECTION UNIT (R1)
INSTALL: R10-5A SIGN
REMOVE (2) 3-SECTIONS AND INSTALL 4-SECTION FYA SIGNAL HEAD
INSTALL ADVANCE RADAR DETECTION UNIT (R6)
INSTALL STOPBAR RADAR DETECTION UNIT (R8)
R560-5
PHASING DIAGRAM
Ø1 Ø2 Ø3 OMIT Ø4
Ø5 Ø6 Ø7 OMIT Ø8
* DESIGN FEATURES
- SUPPLEMENTAL HEADS
- MAST ARMS
- RADAR DETECTION
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
0 30 60 120
REVISION DATES
STATE OF GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
SIGNAL PLANS
SR 92 (CROSSVILLE RD) @ BENT GRASS RD


PHASING DIAGRAM
Ø1 OMIT
Ø2
Ø3
Ø4
Ø5
Ø6
Ø7 OMIT
Ø8 OMIT
LED SIGNAL HEAD DISPLAY
2,3,4,6
3A, 4B
4A, 5
6A
P2, P3, P4, P6
18"
PEDESTRIAN SIGNS
R10-3E(L) 9"X15"
R10-3E(R) 9"X15"
REGULARTORY SIGNS
R1-2 36" X 36"
R10-5 24" X 30"
R10-5A
R560-5
OVERHEAD STREETNAME SIGNS
SR 85
D3-1*1 2 EA.
Pointe S Pkwy
D3-1*2 2 EA.
SR 85
SPEED LIMIT = 55 MPH
POINTE SOUTH PKWY
SPEED LIMIT = 35 MPH
EXISTING 6'X40' PRESENCE LOOP (TYP)
INSTALL: 3-SECTION FYA SIGNAL HEAD
INSTALL: R10-5A SIGN
R1-2 SIGN
EXISTING CL4D CABINET WITH 2070 CONTROLLER POWER DISCONNECT AND METER BASE ASSEMBLY
PULLBOX SHALL BE RELOCATED BY COUNTY
R560-5 SIGN
REALIGN EXISTING SIGNAL HEAD
REMOVE 3-SECTION AND INSTALL: 4-SECTION FYA SIGNAL HEAD
REALIGN EXISTING SIGNAL HEAD
EXISTING MAST ARM (TYP)
REALIGN EXISTING SIGNAL HEAD
REMOVE 3-SECTION AND INSTALL: 4-SECTION FYA SIGNAL HEAD
EXISTING 6'X6' SETBACK DETECTION: 410' FROM STOP BAR (TYP)
ONLY ONLY
V2A
V2B
V3
V4A
V4B
V5A
V5B
V6A
V6B
* DESIGN FEATURES
- PERMISSIVE FLASHING YELLOW ARROW (FYA)
- IVSD
- SPLIT PHASING
* DESIGN FEATURES
- PROTECTED ONLY LEFT
- MAST ARMS
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
0 30 60 120
REVISION DATES
STATE OF GEORGIA DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
EXISTING CONDITIONS
SR 85 @ POINTE SOUTH PKWY
STATE GA
COUNTY CLAYTON
MAINTAINING AGENCY CLAYTON CO.
GDOT INTERSECTION NUMBER 000727


STATE
GA.
PROJECT NUMBER
SHEET NUMBER
TOTAL SHEETS
PHASING DIAGRAM
Ø1
Ø2
Ø3
OMIT
Ø4
OMIT
Ø5
OMIT
Ø6
Ø7
OMIT
Ø8
LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
12"
1
2A
2, 6, 8
8B
18"
P2, P6, P8
R2-1
INSTALL NEW 3 SECTION SIGNAL HEAD
INSTALL NEW 3 SECTION SIGNAL HEAD
R560-5
35 MPH
SR 204 SPUR/WHITEFIELD AVE
ONLY
ONLY
D3-1 #4
R3-1
INSTALL NEW 3 SECTION SIGNAL HEAD
L2C
L2B
L2A
L1
L6A
L6B
L8A
L8B
RAMP WA-NB
RAMP WA-EB
PEDESTRIAN SIGNS
R10-3e(L) (9"X15")
R10-3e(R) (9"X15")
R10-3e(SP) (9"X15")
REGULATORY SIGNS
R1-2
R3-1 Activated Blank-out
R3-2 Activated Blank-out
R9-3a (450)
R560-5
R9-3bL (450)
R9-3bR (450)
OVERHEAD STREETNAME SIGNS
Whitefield Ave
D3-1 #9
N Truman Pkwy
D3-1 #3
N Truman Pkwy
D3-1 #4
D3-1 #9
R9-3a
R9-3b(L)
EXISTING 332 CABINET WITH BASE
POWER DISCONNECT AND METER BASE ASSEMBLY
INSTALL NEW 3 SECTION SIGNAL HEAD
R3-2
EXISTING 6'X40' PRESENCE DETECTION (TYP)
EXISTING 6'X6' SETBACK DETECTION
260' FROM STOP BAR (TYP)
EXISTING STRAIN POLE (TYP)
35 MPH
SR 204 SPUR/WHITEFIELD AVE
ONLY
ONLY
* DESIGN FEATURES
MAST ARMS
LOOP DETECTION
NO PEDESTRIAN CROSSING
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA
DEPARTMENT OF TRANSPORTATION
DATE
REVISIONS
02/15/11 REM PROP 5W AT STA 1+570 RT
02/15/11 REV 6' RAIL ALONG WHITEFIELD UNDER BRIDGE
02/15/11 REV BARRIER WALL ALONG WHITEFIELD, W SIDE
TRAFFIC SIGNAL INSTALLATION
SR 204 Spur/ Whitefield Ave at Harry S Truman NB Ramp
Chatham County

STATE
GA
PROJECT NUMBER
SHEET NO.
TOTAL SHEETS
N
GLOUCESTER ST
F ST
SR 27/US 341
40MPH
SR27/US341/BAY ST
THERMO HATCHING, WHITE, DETAIL A
24" SOLID WHITE THERMO
20 FT
8" SOLID WHITE THERMO
5" SOLID WHITE THERMO
TYPE B RAMP
R1-5B
R1-1
30 FT
40 FT
MP 20.85
RELOCATE R1-1 SIGN
INSTALL SINGLE INDICATED RRFB
INSET 1
4" CONCRETE MEDIAN, TP 7
MATCH CURB HEIGHT
INSTALL DOUBLE INDICATED (BACK TO BACK) RRFB
SEE INSET 2
REGULATORY SIGNS
PUSH BUTTON TO TURN ON WARNING LIGHTS
R10-25
STOP
R1-1
YIELD
R1-2
STOP HERE FOR
R1-5B
WARNING SIGNS
W16-7P (R)
W16-7P (L)
W11-2
W16-7P
RRFB CABINET
42"
7FT
5FT
RECTANGULAR RAPID FLASHING BEACON (RRFB)
NOTE: ERADICATE EXISTING CROSSWALKS AND CONFLICTING STRIPING
INSET 1
7'6"
36"
42"
15:1
LIP OF GUTTER
INSET 2
10'
40"
15:1
30 FT
24"
*DESIGN FEATURES
RRFB
SCALE IN FEET
0
30
60
120
GEORGIA
DEPARTMENT
OF
TRANSPORTATION
DATE
REVISIONS
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
SR27/US341 AT F STREET
RETANGULAR RAPID FLASHING BEACON
CITY OF BRUNSWICK
GLYNN COUNTY


STATE
GA
PROJECT NUMBER
SHEET NO.
TOTAL SHEETS
2/8/2016
juhatch
11:09:23 AM
GPLOT-V8
gplotborder-v8I-P0.tbl
Design Examples.dgn
PEDESTRIAN HYBRID BEACON SEQUENCE
DARK
DON'T WALK
FLASHING YELLOW
STEADY YELLOW
STEADY RED
WALK
WIG-WAG FLASHING RED
FLASHING DON'T WALK & COUNTDOWN
PHASING DIAGRAM
Ø1 OMIT
Ø2 OMIT
Ø3 OMIT
Ø4 OMIT
Ø5
Ø6
Ø7 OMIT
Ø8 OMIT
LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATES
PEDESTRIAN HYBRID BEACON
6
P5
INSTALL:
-STEEL STRAIN POLE, TP IV, WITH 50 FT MAST ARM
-STA. 11+49, 25.6' LT
-LED COUNTDOWN PEDESTRIAN SIGNAL HEAD, P5
-PEDESTRIAN PUSH BUTTONS AND SIGNS
-REQUIRED SIGNS W11-2 & W16-7P(L,R)
-CABINET
-PULL BOX, PB-TP 3
-REQUIRED CONDUIT PER GDOT DETAILS
EXIST. SIDEWALK
STRAIN POLE
STA. 11+49, 25.6' LT.
ST LOUIS PL NE
BRIARCLIFF PL
R10-6
R1-9A
W11-2
R10-23
SR 42/BRIARCLIFF RD. NE
SPEED LIMIT = 35 MPH
24" STOPBAR
40' FEET FROM SIGNAL HEAD
INSTALL:
-DIRECTIONAL BORE, 7 IN
-CONDUIT, NONMETAL, TP 3, 2 IN, (2 EA)
REGULATORY SIGNS
PEDESTRIAN SIGNS
*DESIGN FEATURES
- PEDESTRIAN HYBRID BEACON (SINGLE STAGE CROSSING)
STATE LAW
STOP FOR PEDESTRIANS
R1-9A
90" x 24"
CROSSWALK STOP ON RED
R10-23
24" x 30"
STOP HERE ON RED
R10-6
24" x 36"
W16-7P(L)
30" x 18"
W16-7P(R)
30" x 18"
W11-2
36" x 36"
R10-3E(L)
9' x 15'
R10-3E(R)
9' x 15'
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
EXISTING SIGNAL HEAD
PROPOSED PEDESTRIAN HYBRID BEACON
RELOCATED SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA
DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
0 30 60 120
REVISION DATES
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: DISTRICT 7 DESIGN
SIGNAL PLANS
SR 42/BRIARCLIFF RD NE
PEDETRIAN HYBRID BEACON
MID BLOCK CROSSING
DRAWING No.
27-
12/14/2012
GPLN

SR 42/BRIARCLIFF RD. NE
SPEED LIMIT = 35 MPH
BRIARCLIFF PL
ST LOUIS PL NE
EXIST. SIDEWALK
24" STOPBAR
40' FEET FROM SIGNAL HEAD
STRAIN POLE
STA. 11+49, 25.6' LT.
STRAIN POLE
STA. 11+45, 25.6' LT.
INSTALL:
-DIRECTIONAL BORE, 7 IN
-CONDUIT, NONMETAL, TP 3,
2 IN. (2 EA)
INSTALL:
-STEEL STRAIN POLE, TP IV, WITH 50 FT
MAST ARM
-STA. 11+49, 25.6' LT
-LED COUNTDOWN PEDESTRIAN SIGNAL HEAD,
P5
-PEDESTRIAN PUSH BUTTONS AND SIGNS
-REQUIRED SIGNS W11-2 & W16-7P(L,R)
-CABINET
-PULL BOX, PB-TP 3
-REQUIRED CONDUIT PER GDOT DETAILS
R10-6
W11-2
R1-9A
R10-23
LED SIGNAL HEADS WITH
RETRO-REFLECTIVE BACK PLATES
PEDESTRIAN HYBRID
BEACON
PEDESTRIAN HYBRID BEACON SEQUENCE
DARK
DON'T WALK
FLASHING YELLOW
STEADY YELLOW
STEADY RED
WALK
WIG-WAG FLASHING RED
FLASHING DON'T WALK & COUNTDOWN
PHASING DIAGRAM
OMIT
PEDESTRIAN SIGNS
R10-3E(L) R10-3E(R)
9' x 15' 9' x 15'
W11-2
36" x 36"
REGULATORY SIGNS
W16-7P(L)
30" x 18"
W16-7P(R)
30" x 18"
R10-6
24" x 36"
STOP HERE ON RED
CROSSWALK STOP ON RED
R10-23
24" x 30"
STATE LAW
STOP FOR PEDESTRIANS
R1-9A
90" x 24"
* DESIGN FEATURES
- PEDESTRIAN HYBRID BEACON
(DOUBLE STAGE CROSSING)
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED PEDESTRIAN HYBRID BEACON
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA
DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
REVISION DATES
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: DISTRICT 7 DESIGN
SIGNAL PLANS
SR 42/BRIARCLIFF RD NE
PEDESTRIAN HYBRID BEACON
MID BLOCK CROSSING
DRAWING No.
27-
STATE
GA
PROJECT NUMBER
SHEET NO.
TOTAL SHEETS


LED SIGNAL HEADS WITH RETRO-REFLECTIVE BACK PLATE
1,3,5
2,4,6,8
4A
P2,P4,P6,P8
INSTALL: FLUSH MOUNT WIRELESS T-SENSORS (4 EA) AND FLUSH MOUNT WIRELESS F-SESNORS (2 EA) FOR PHASE 4 DETECTION AREAS (6'X'40)
EXISTING R1-2 SIGN
INSTALL IN EXISTING CABINET: ACCESS POINT CONTACT CLOSURE CARD (APCC-M-E, 1 EA) EXPANSION CARD (1 EA) ISOLATOR (3 EA)
EXISTING R10-5A SIGN
EXISTING OVERHEAD STREETNAME SIGN (D3-1*1)
EXISTING R1-2 SIGN
EXISTING R560-5 SIGN
INSTALL: FLUSH MOUNT WIRELESS F-SENSORS (2 EA) FOR DETECTION AREAS (6'X6') (TYP) 410' FROM STOP BAR
EXISTING R5-1 SIGN
SR 74
SPEED LIMIT = 55 MPH
M2A
M2B
M5A
M5B
REGULATORY SIGNS
R1-2
R10-5A
R560-5
PEDESTRIAN SIGNS
R10-3E(L) 9"X15"
R10-3E(R) 9"X15"
OVERHEAD STREET NAME SIGNS
Joel Cowan Pkwy
D3-1*1
Georgian Park
D3-1*2R
Georgian Park
D3-1*2L
Ardenlee Pkwy
D3-1*3R
Ardenlee Pkwy
D3-1*3L
EXISTING R1-2 SIGN
EXISTING R10-5A SIGN
EXISTING OVERHEAD STREETNAME SIGN (D3-1*3L)
EXISTING OVERHEAD STREETNAME SIGN (D3-1*2R)
EXISTING R560-5 SIGN
INSTALL: FLUSH MOUNT WIRELESS T-SENSORS (4 EA) AND FLUSH MOUNT WIRELESS F-SESNORS (2 EA) FOR PHASE 3 AND 8 DETECTION AREAS (6'X'40) (TYP)
ARDENLEE PKWY
SPEED LIMIT = 25 MPH
GEORGIAN PARK
SPEED LIMIT = 25 MPH
M4A
M4B
M4C
M4D
M8A
M8B
M3A
M3B
M1A
M1B
M6A
M6B
EXISTING R560-5 SIGN
EXISTING OVERHEAD STREETNAME SIGN (D3-1*3R)
EXISTING OVERHEAD STREETNAME SIGN (D3-1*2L)
EXISTING R10-5A SIGN
EXISTING R1-2 SIGN
INSTALL: FLUSH MOUNT WIRELESS T-SENSORS (2 EA) AND FLUSH MOUNT WIRELESS F-SESNORS (1 EA) FOR PHASE X DETECTION AREAS (6'X40) (TYP)
EXISTING R5-1 SIGN
EXISTING OVERHEAD STREETNAME SIGN (D3-1*1)
EXISTING R560-5 SIGN
EXISTING R1-2 SIGN
INSTALL: 20' EXPOSED HEIGHT BLACK FIBERGLASS POLE WITH FLEX REPEATERS FOR PHASE 6 ON 10' EXTENSION ARM (TYP)
SPP RADIO FOR PHASE X AND X ON EXISTING STRAIN POLE CAT 5E CABLE THROUGH EXISTING CONDUIT FROM SPP RADIO TO APCC IN EXISTING CABINET (355 LF)
PHASING DIAGRAM
OMIT
WIRELESS SENSORS DETAIL (TYP)
PULSE DETECTION
PRESENCE DETECTION
* DESIGN FEATURES - MAGNETOMETER DETECTION
SIGNAL LEGEND
PROPOSED SIGNAL HEAD
EXISTING SIGNAL HEAD
RELOCATED SIGNAL HEAD
PROPOSED 4-SECTION SIGNAL HEAD
PROPOSED 5-SECTION OR 4-SECTION SIGNAL HEAD
PEDESTRIAN SIGNAL HEAD
DETECTION LEGEND
PROPOSED VIRTUAL DETECTION ZONE
PROPOSED INDUCTIVE LOOP
PROPOSED VIDEO DETECTION CAMERA
PROPOSED MAGNETOMETER
PROPOSED RADAR
GEORGIA DEPARTMENT OF TRANSPORTATION
SCALE IN FEET
0 20 40 80
REVISION DATES
DSH 8/12/2015
STATE OF GEORGIA
DEPARTMENT OF TRANSPORTATION
OFFICE: TRAFFIC OPERATIONS
SIGNAL PLANS
SR 74 @ GEORGIAN PARK
DRAWING No.
27-01

Appendix B: Vehicular Signal Head Placement Examples

List of Figures:

Appendix B1

The following figures are intended to assist a designer in determining traffic signal head configurations for a given approach based on the number of lanes and the movements allowed for each lane. GDOT's preferred/typical signal head arrangement is provided in the center of each intersection figure, while options based on various criteria are provided above select intersection figures. These figures are intended as a guide. The signal head configuration for each approach is subject to engineering judgment and the approval of the State Traffic Engineer.

Appendix B-1. Permissive Left Turns

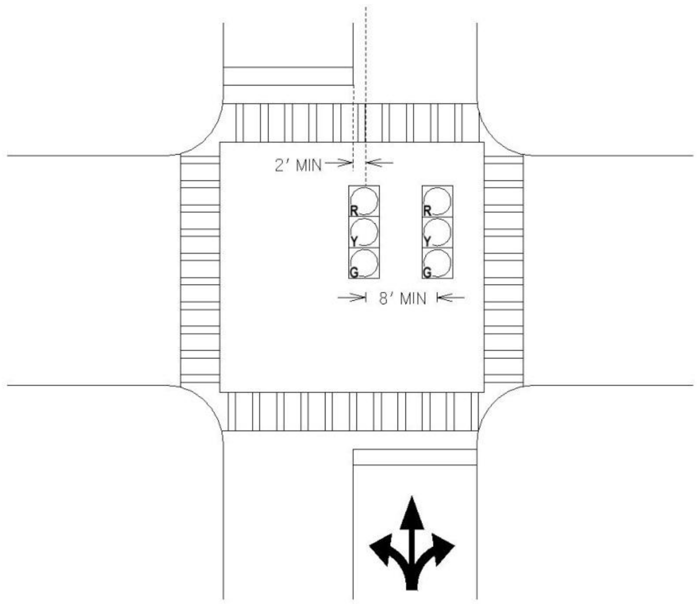


Figure B- 1-1: Single Lane Approach

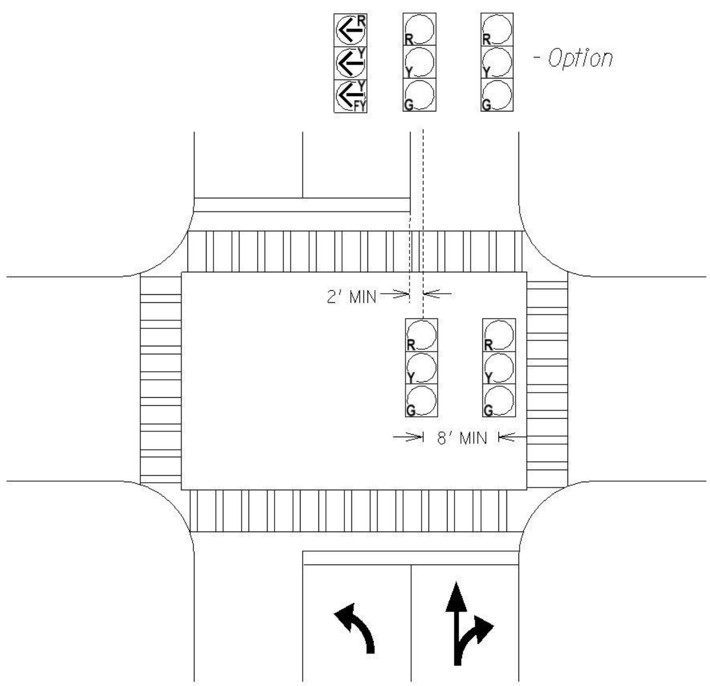


Figure B- 1-2: Single Left Turn Lane

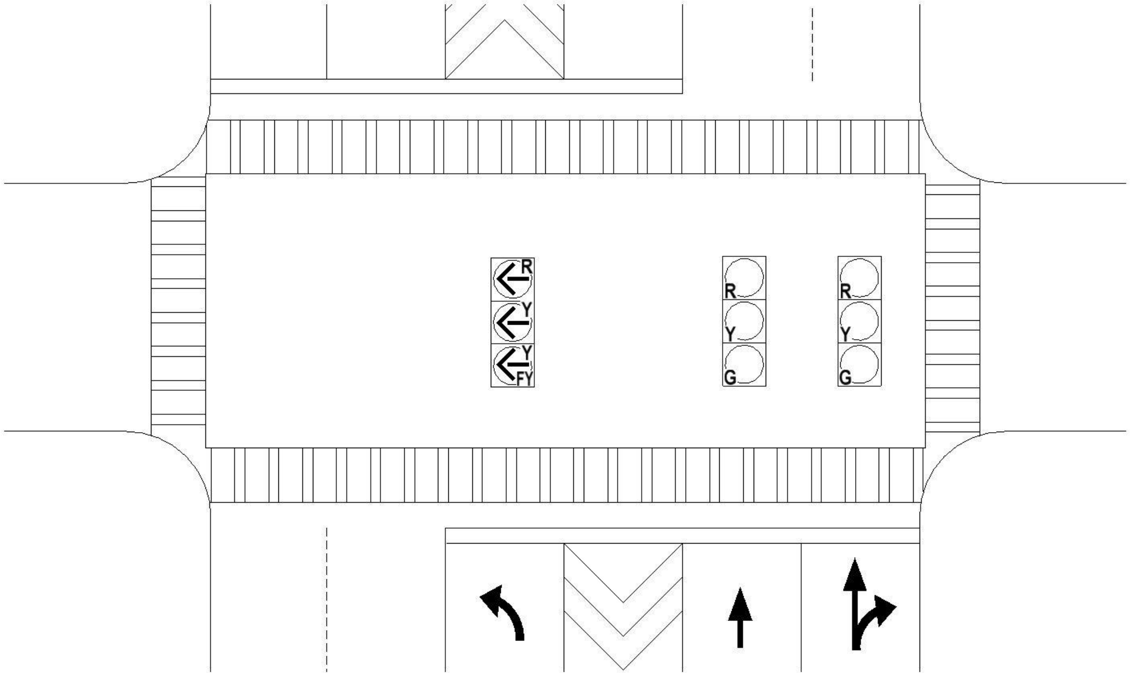


Figure B- 0-3: Single Lane Median Separated Left Turn Lane

Appendix B-2. Protected/Permissive Left Turns

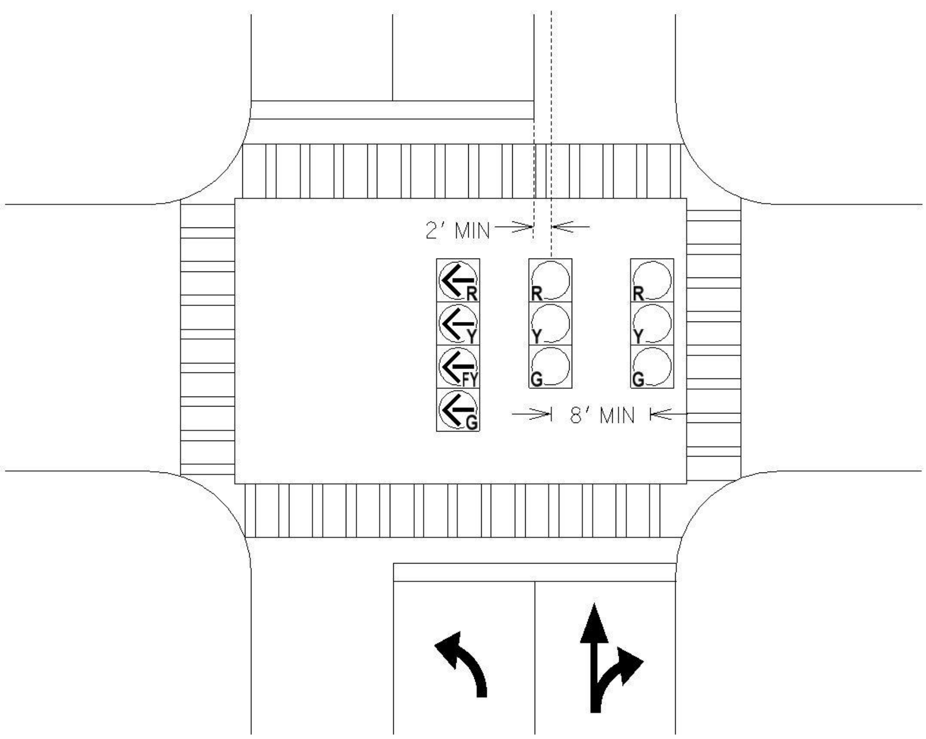


Figure B- 2-1: Single Left Turn Lane

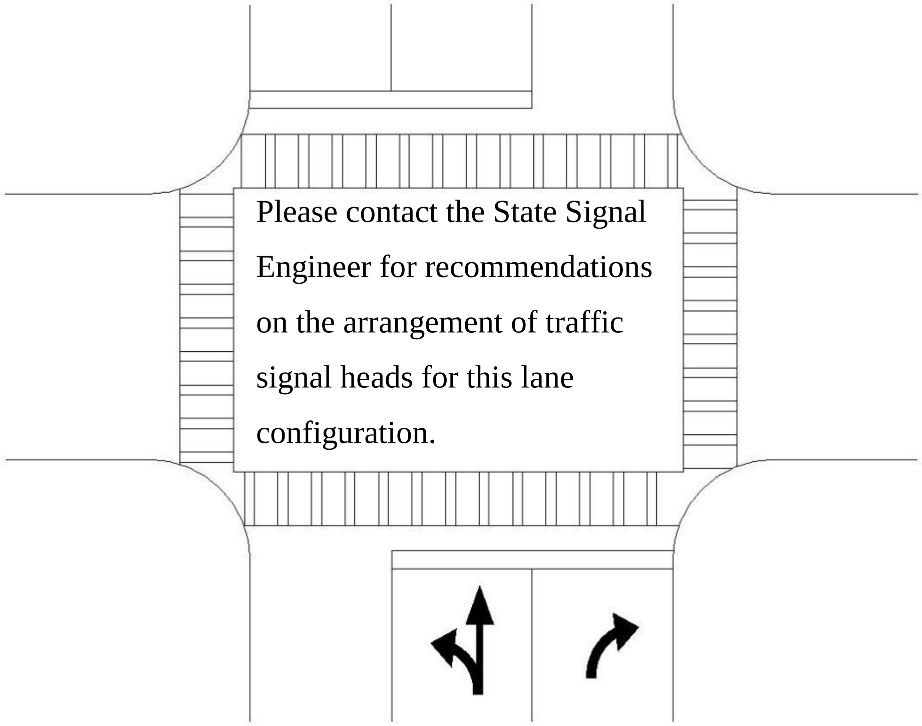


Figure B- 2-2: Combination Thru-Left Turn Lane with Protected/Permissive Phasing

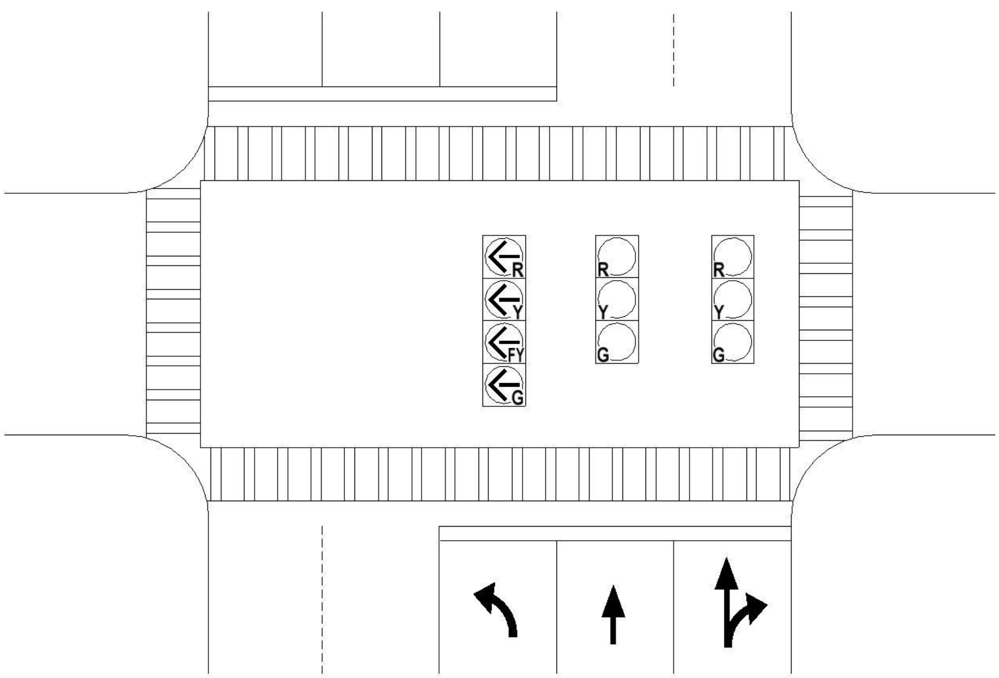


Figure B- 2-3: Single Left Turn Lane

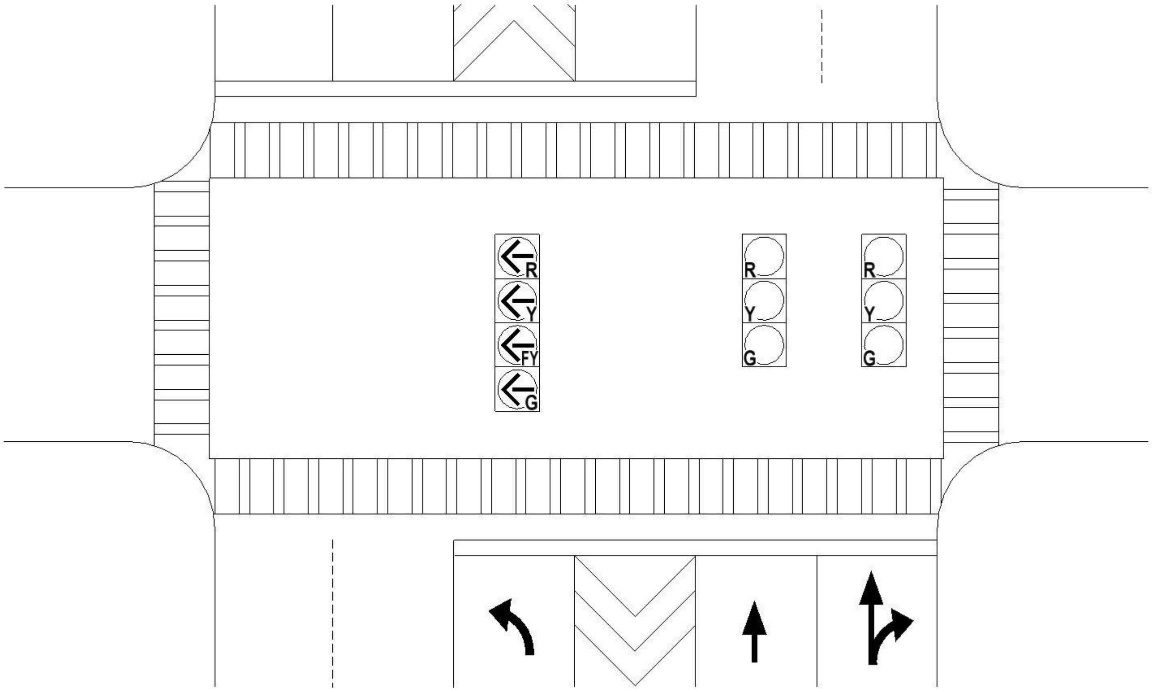


Figure B- 2-4: Single Median Separated Left Turn Lane

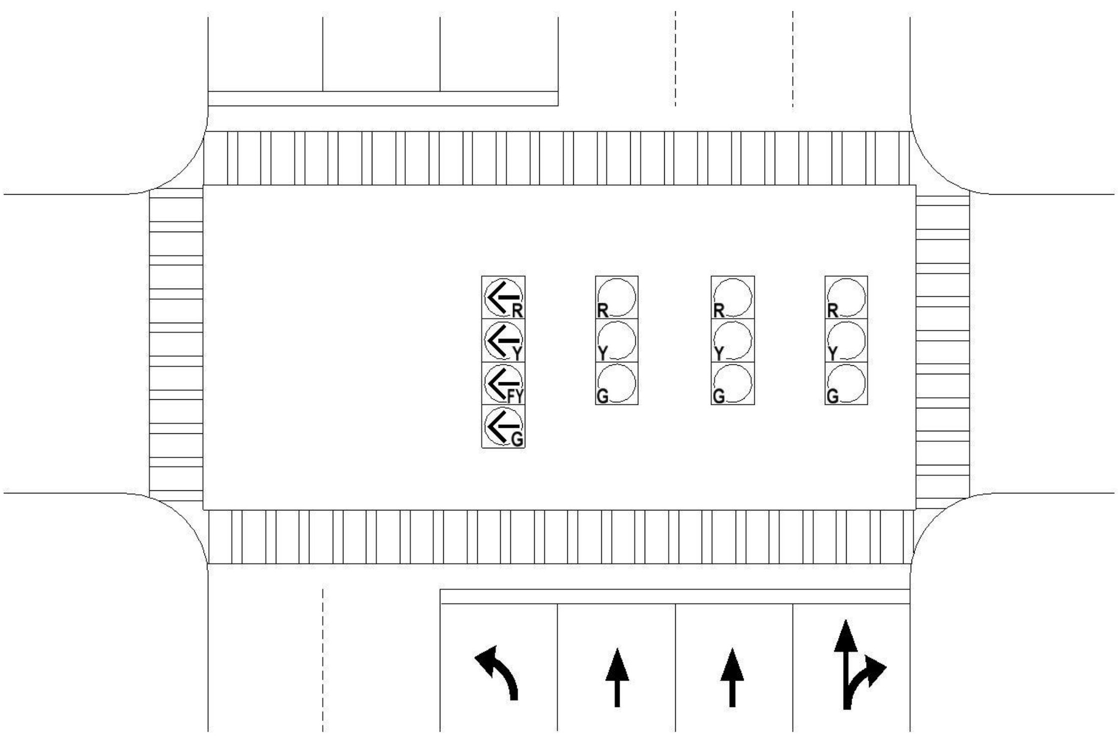


Figure B- 2-5: Single Left Turn Lane w/ Two Thru Lanes and Thru/Right Lane

Appendix B-3. Protected Only Left Turns

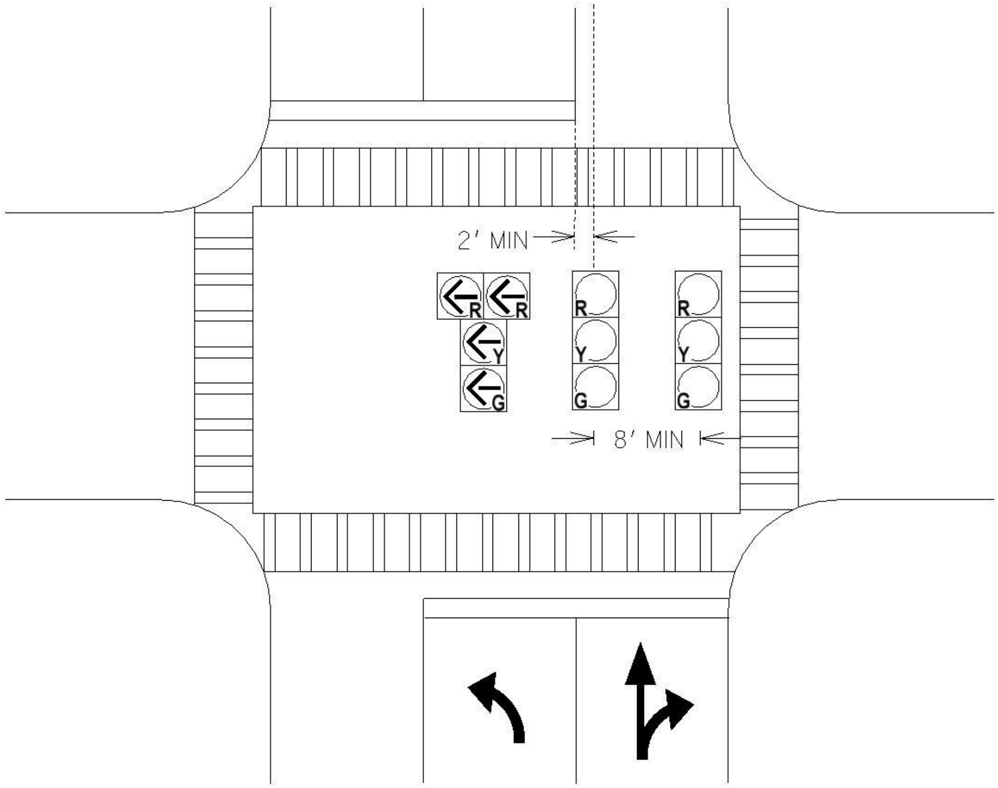


Figure B- 3-1: Single Left Turn Lane

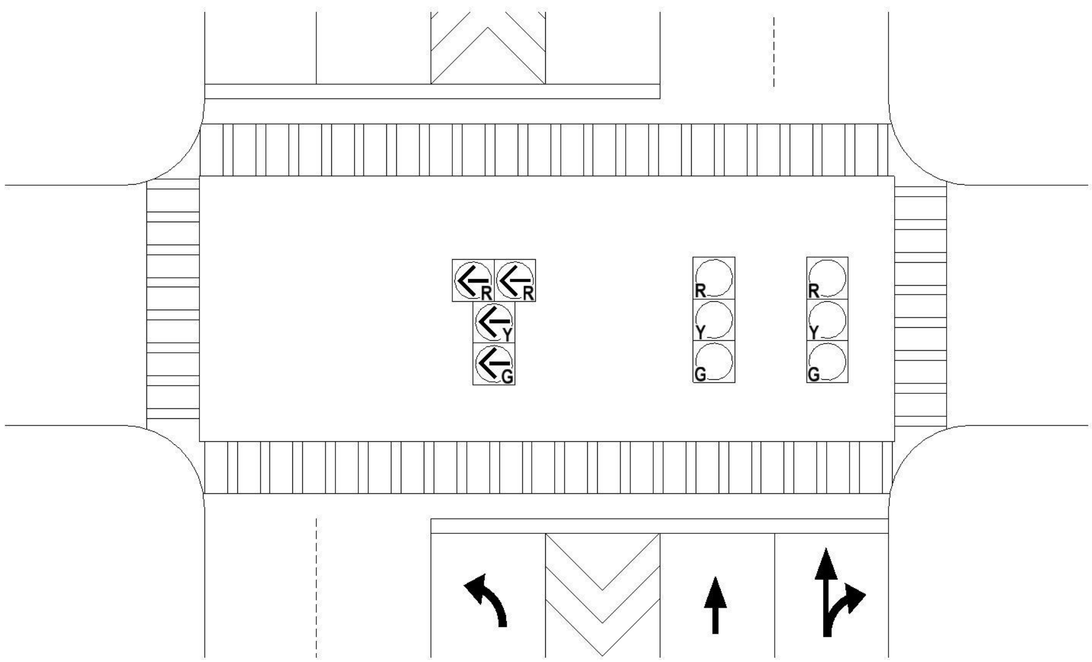


Figure B- 3-2: Single Median Separated Left Turn Lane

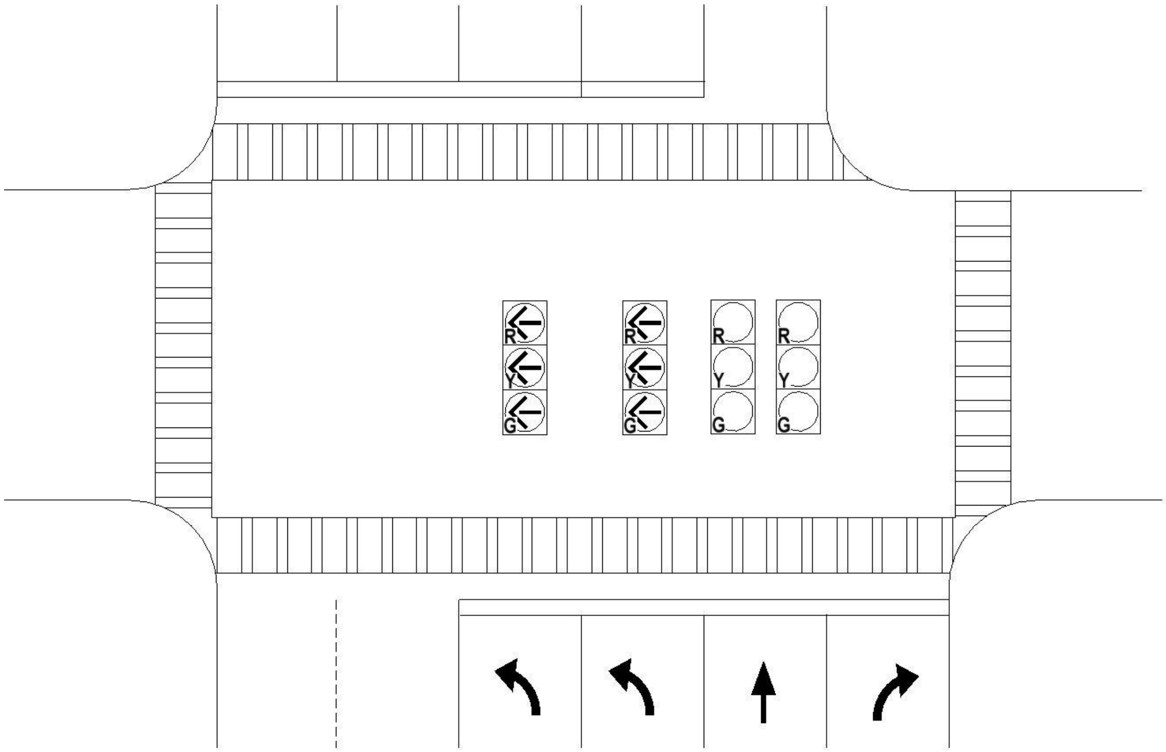


Figure B- 3-3: Dual Left Turn Lanes with Thru and Right Lanes

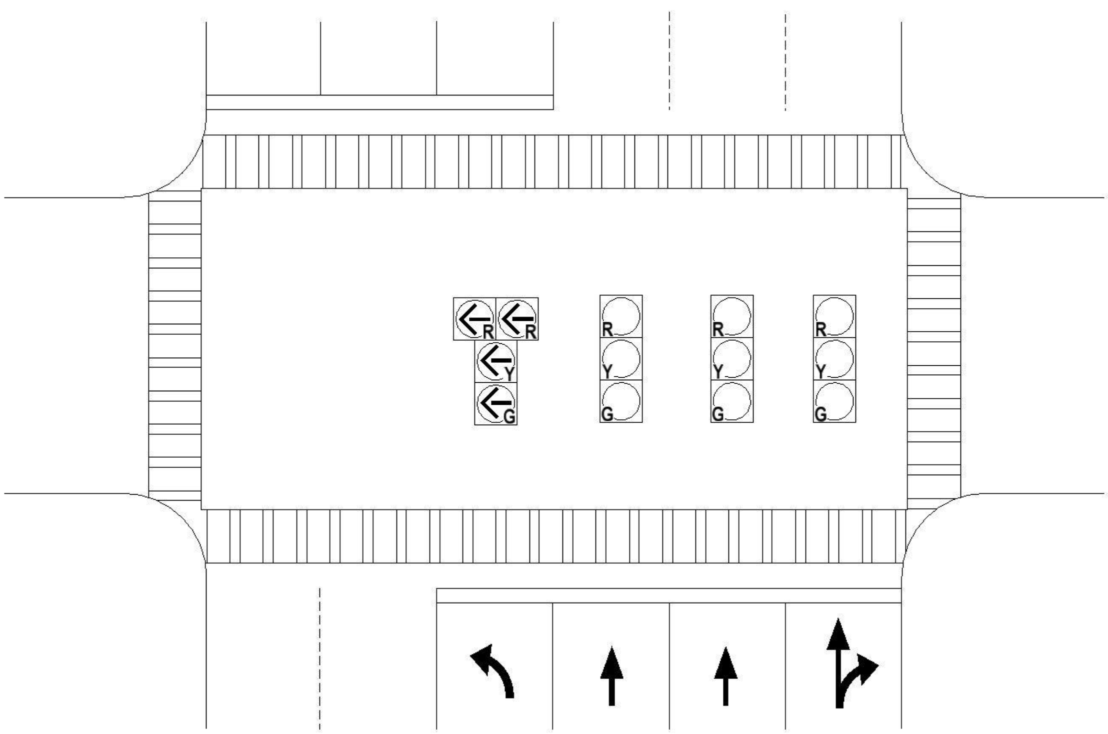


Figure B- 3-4: Single Left Turn Lane W/ Two Thru Lanes and Thru/Right Lane

Appendix B-4. Split Phasing

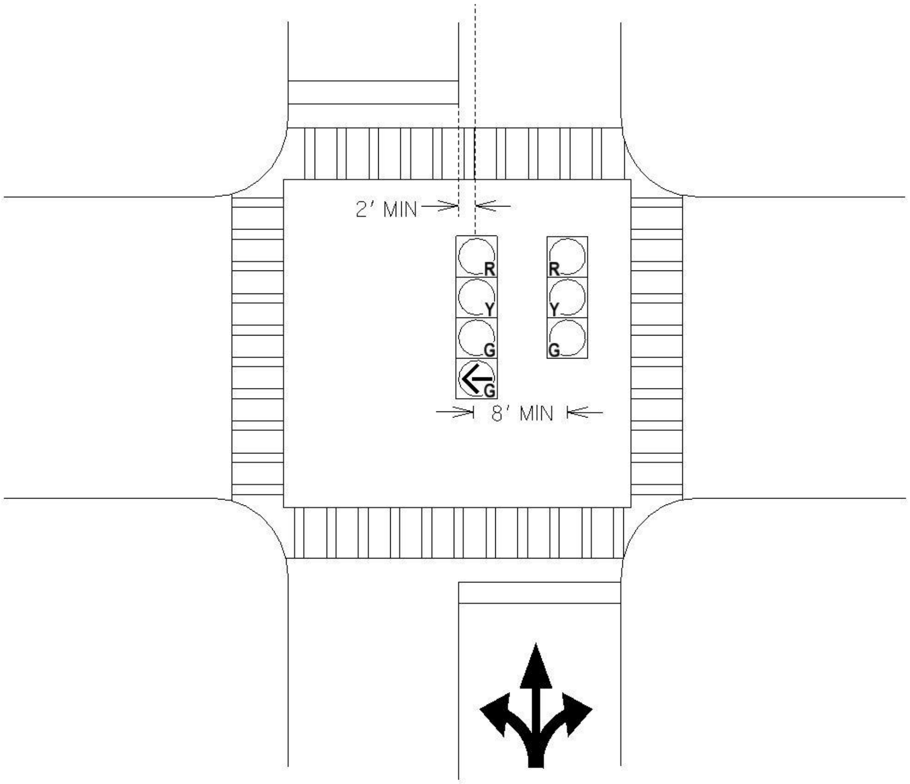


Figure B- 4-1: Single Lane Approach

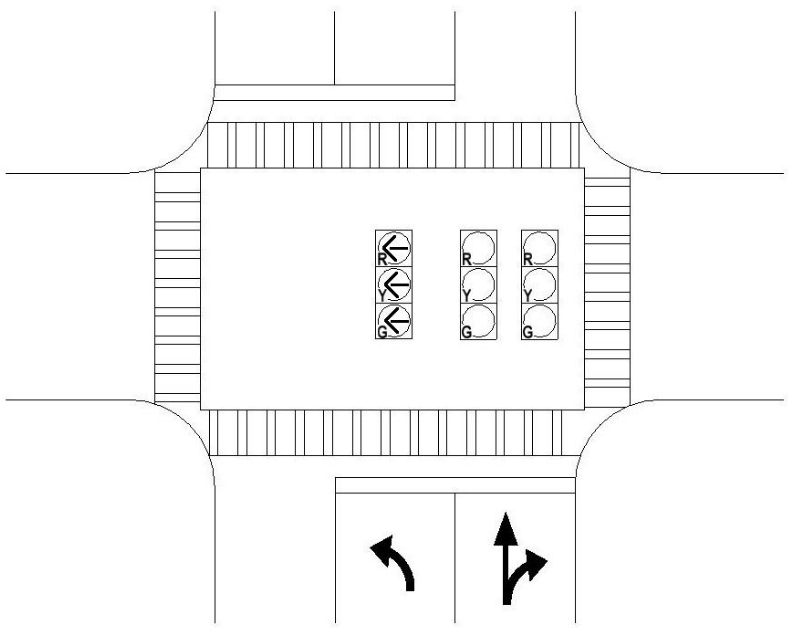


Figure B- 4-2: Single Left Turn Lane

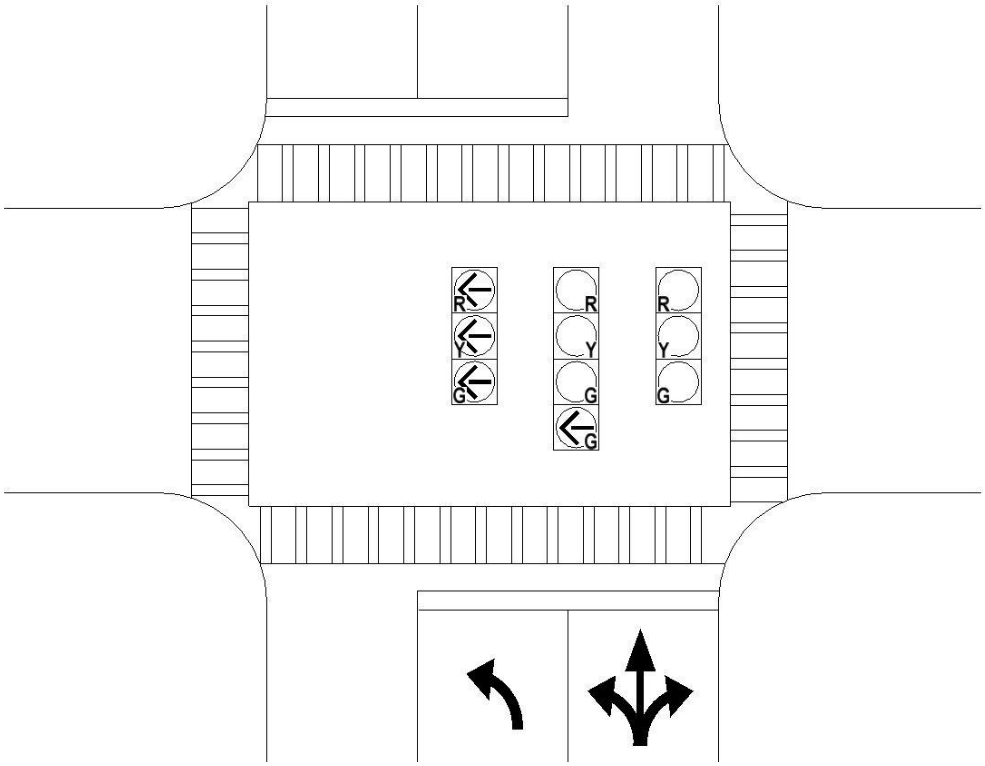


Figure B- 4-3: Left Turn Lane W/ Combination Left Turn/Thru/Right Turn Lane

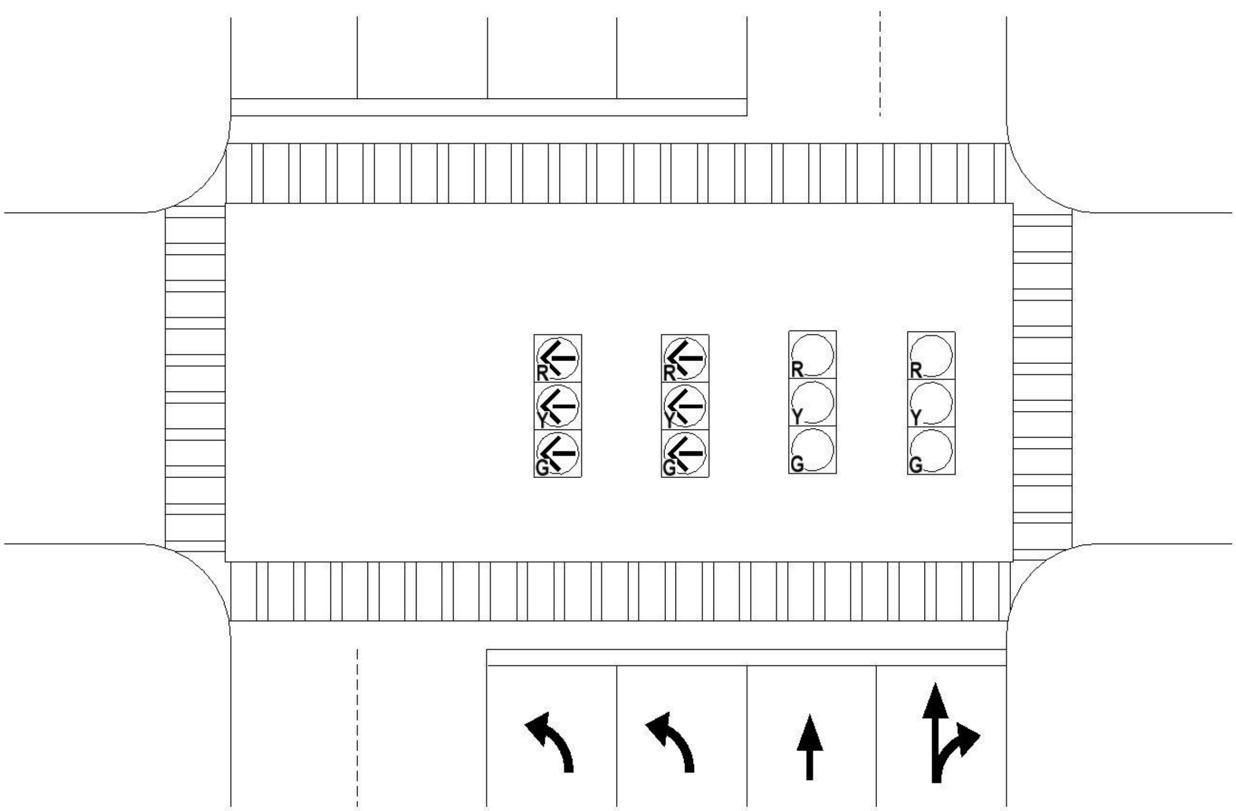


Figure B- 4-4: Dual Left Turn Lanes With Thru Lane and Thru/Right Lane

Appendix B-5. T-Intersection

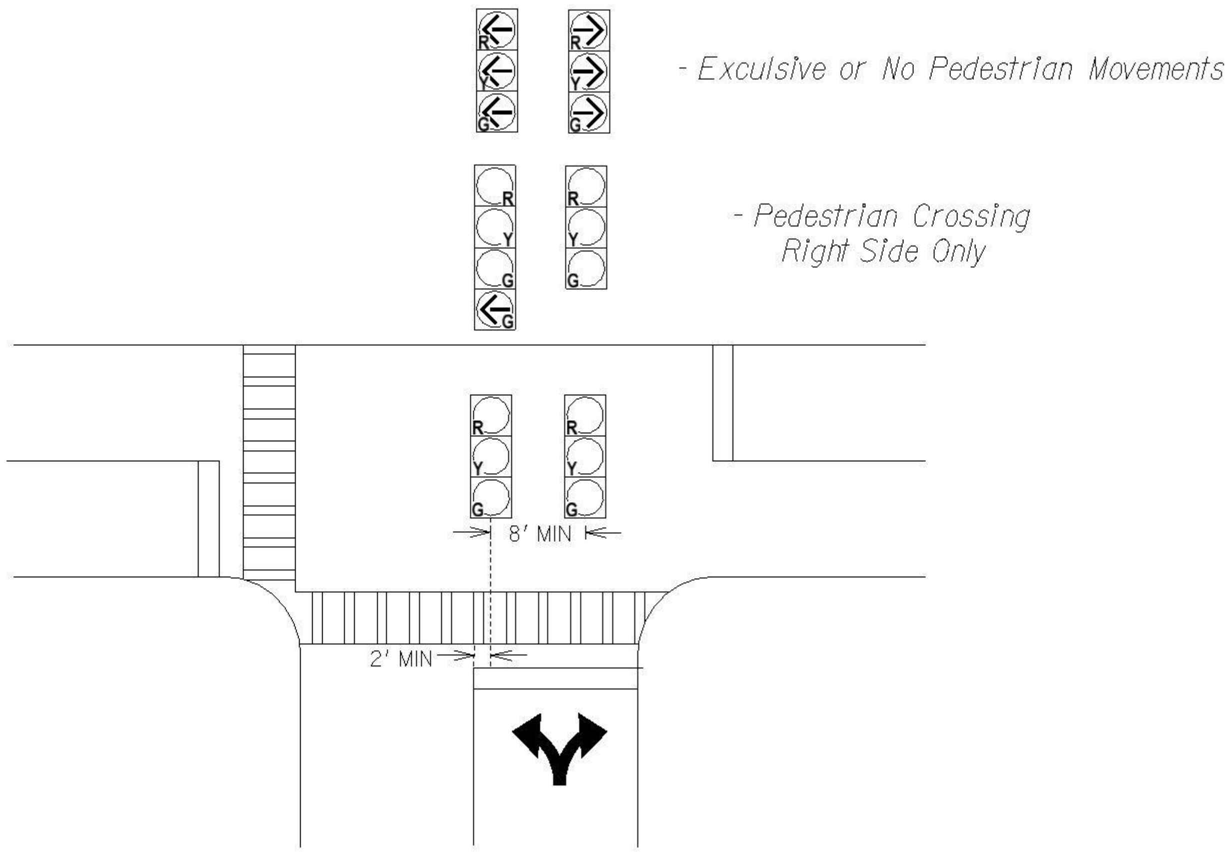


Figure B- 5-1: Single Lane Approach

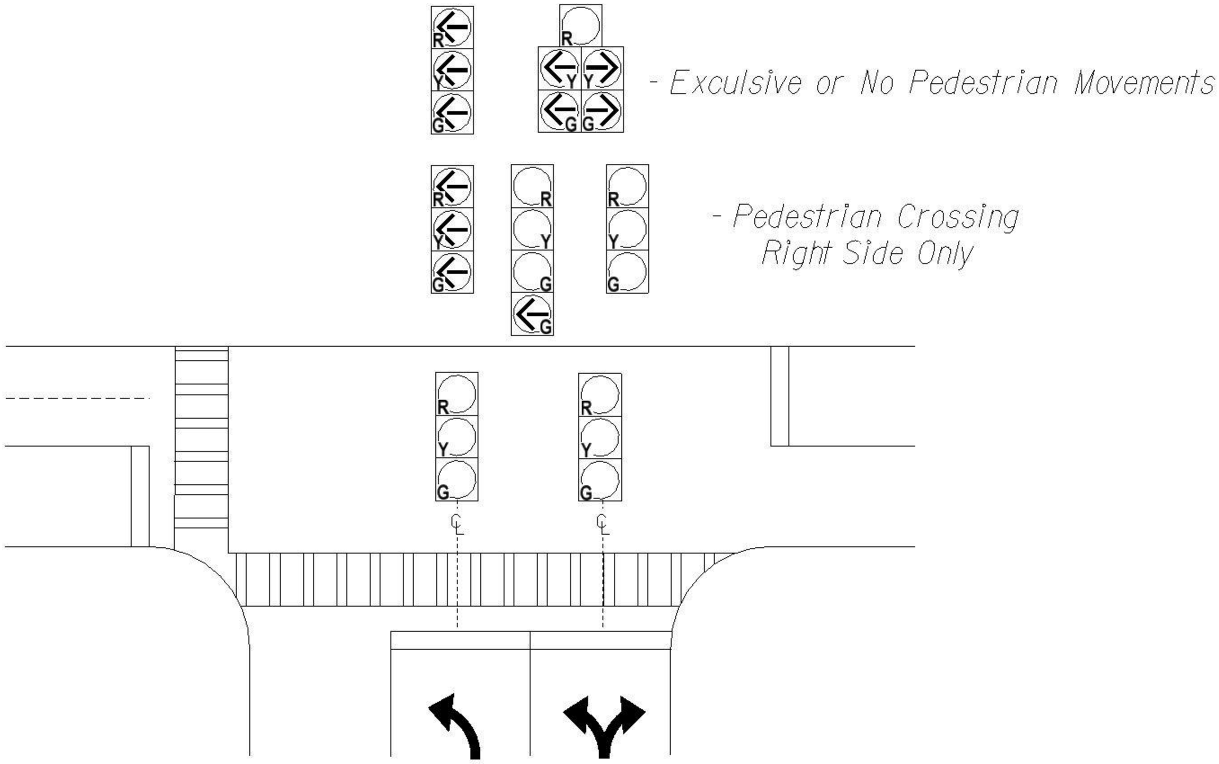


Figure B- 5-2: Separate Left Turn Lane Combination Left Turn/Right Turn Lane

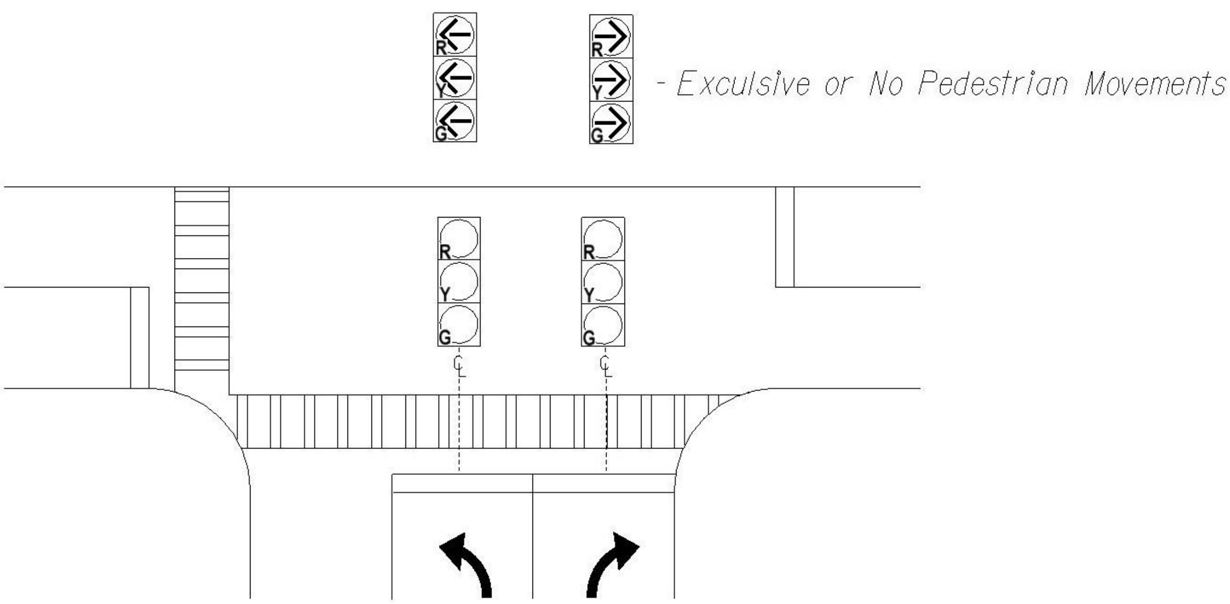


Figure B- 5-3: Separate Left and Right Turn Lanes

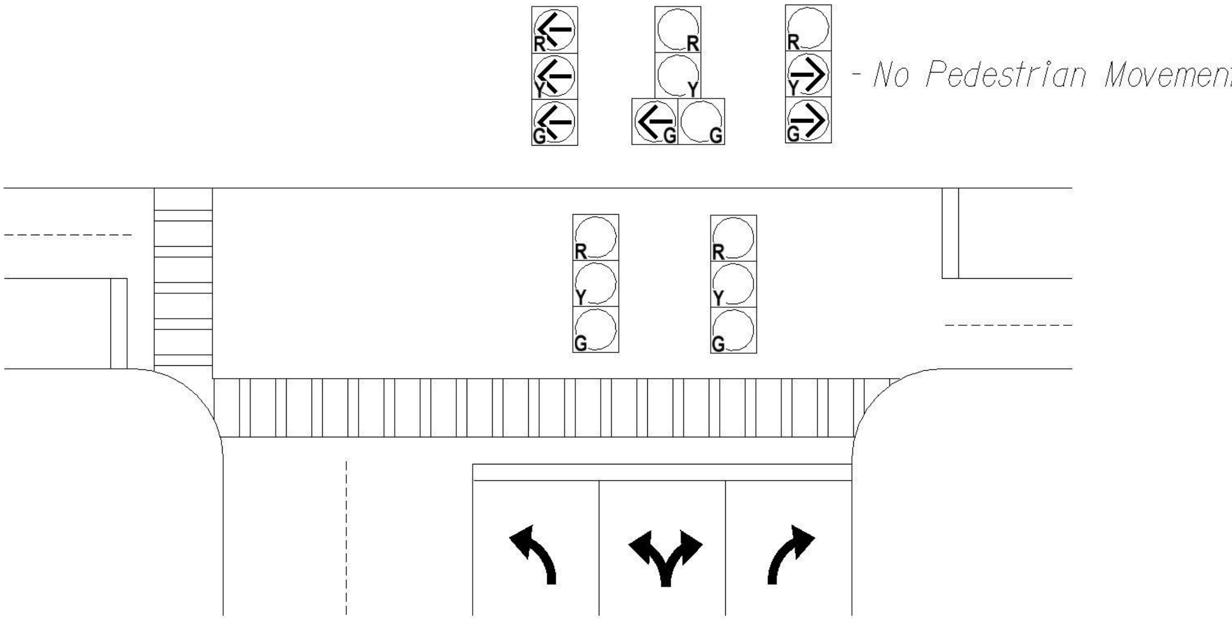


Figure B- 5-4: Separate Left Turn Lane and Right Turn Lane with Shared Center Lane

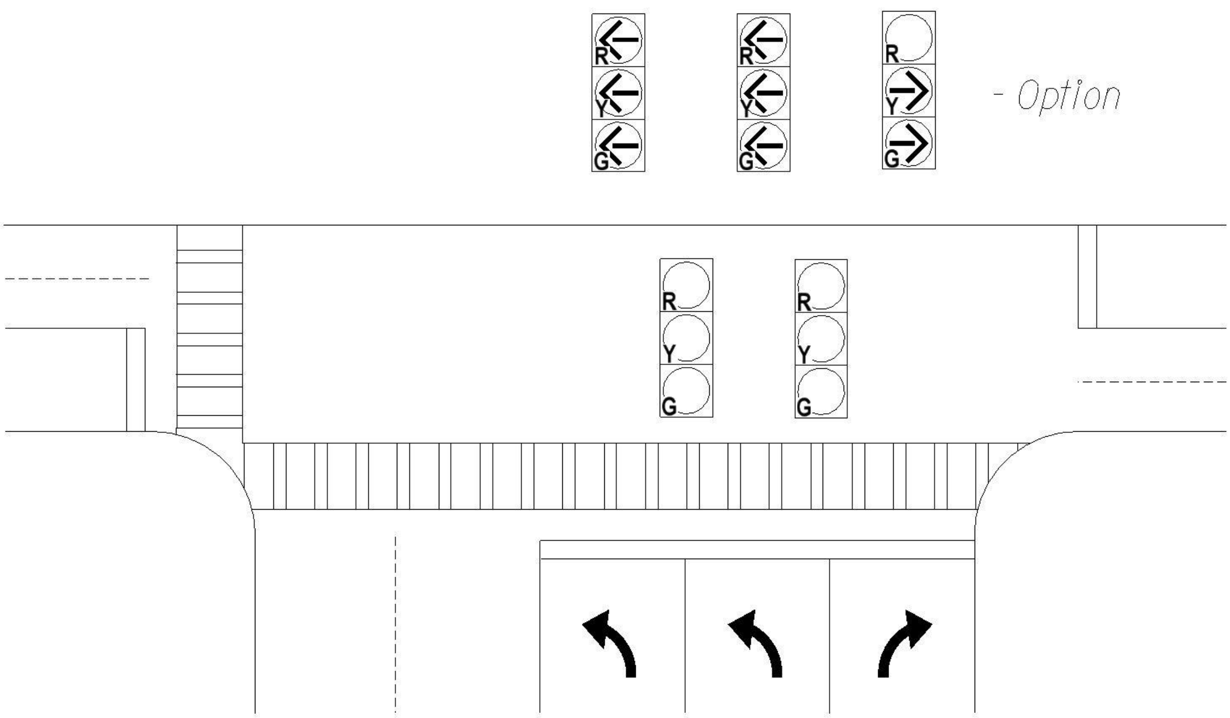


Figure B- 5-5: Dual Left Turn Lanes with Separate Right Turn Lane

Appendix C: Signal Interconnect Pay Items

- Underground
  - 615-1200 Directional Bore, 3”
  - 615-1200 Directional Bore, 5”
  - 647-2140 Pull Box Type 4
  - 647-2150 Pull Box Type 5
  - 682-6222 Conduit, Nonmetal, Tp 2, 2”
  - 682-6233 Conduit, Nonmetal, Tp 3, 2”
  - 935-1113 Outside Plant Fiber Optic Cable, Loose Tube, SM, 24 Fiber
  - 935-1511 Outside Plant Fiber Optic Cable, Drop, SM, 6 Fiber
  - 935-3103 Fiber Optic Closure, Underground, 24 Fiber
  - 935-4010 Fiber Optic Splice, Fusion
  - 935-5050 Fiber Optic Patch Cord, SM
  - 935-6562 External Transceiver, Drop and Repeat, 1310 SM (Signal Jobs)
  - 935-8000 Testing (Fiber)
  - 939-2300 Field Switch Type A
  - 939-2301 Field Switch Type B
  - 939-2305 Field Switch Type C
  - 939-2230 GBIC, Type LX
  - 939-2232 GBIC, Type EX
  - 939-2235 GBIC, Type ZX
  - 939-8000 Testing (Field Switch)

- Aerial
  - 647-2140 Pull Box Type 4
  - 682-6222 Conduit, Nonmetal, Tp 2, 2”
  - 682-9010 Service Pole Riser
  - 935-1113 Outside Plant Fiber Optic Cable, Loose Tube, SM, 24 Fiber
  - 935-1511 Outside Plant Fiber Optic Cable, Drop, SM, 6 Fiber
  - 935-3201 Fiber Optic Closure, Aerial (Sealed), 6 Fiber
  - 935-3602 Fiber Optic Closure, FDC, Pre-Terminated, Type A, 6 Fiber
  - 935-4010 Fiber Optic Splice, Fusion
  - 935-5050 Fiber Optic Patch Cord, SM
  - 935-5060 Fiber Optic Snowshoe
  - 935-6562 External Transceiver, Drop and Repeat, 1310 SM (Signal Jobs)
  - 935-8000 Testing (Fiber)
  - 939-2300 Field Switch Type A
  - 939-2301 Field Switch Type B
  - 939-2305 Field Switch Type C
  - 939-2230 GBIC, Type LX

    - 939-2232 GBIC, Type EX
    - 939-2235 GBIC, Type ZX
    - 939-8000 Testing (Field Switch)

- Wireless
    - 926-2500 3G (CDMA) Cellular Router Type - A
    - 926-2500 3G (CDMA) Cellular Router Type - B
    - 926-2500 4G (LTE) Cellular Router Type - A
    - 926-2500 4G (LTE) Cellular Router Type - B
    - 927-0200 Rack Mount Spread Spectrum Wireless Transceiver with FSK &
    - 927-0300 2070 Mount Spread Spectrum Wireless Transceiver with RS 232
    - 927-0400 Self Contained Spread Spectrum Wireless Radio Repeater
    - 927-0500 Directional Radio Antenna and Connecting Cable
    - 927-0600 Omni Directional Radio Antenna and Connecting Cable
    - 927-0700 Antenna Power Divider
    - 927-0800 Spread Spectrum Wireless Radio Survey
    - 927-0900 Spread Wireless Training

Appendix D: Examples of Signal Head Detail Cells

A. 4-Section Flashing Yellow Arrow Signal Head(Left turn movement)
B. 4-Section Flashing Yellow Arrow Signal (Right turn movement)
C. 4-Section Signal Head with Green Arrow
D. 3-Section Signal Head
E. 3-Section Signal Head with Left Turn Arrow Inserts
F. 3-Section Signal Head with Right Turn Arrow Inserts
G. 3-Section Signal Head with Through Arrow Inserts
H. 3-Section Signal Head with Green only Through Arrow Insert
I. 3-Section Signal Head with U-Turn Arrow Inserts
J. 3-Section Permissive Flashing Yellow Arrow Signal Head
K. 3-Section Flashing Yellow Arrow Signal Head (Yellow and yellow bimodal)
L. 5-Section Signal Head (Dog House)
M. 4-Section "Inverted T Shaped" Signal Head with Green Arrow Insert
N. 4-Section "T Shaped" Signal Head with Left Arrow Inserts
O. 4-Section "T Shaped" Signal Head

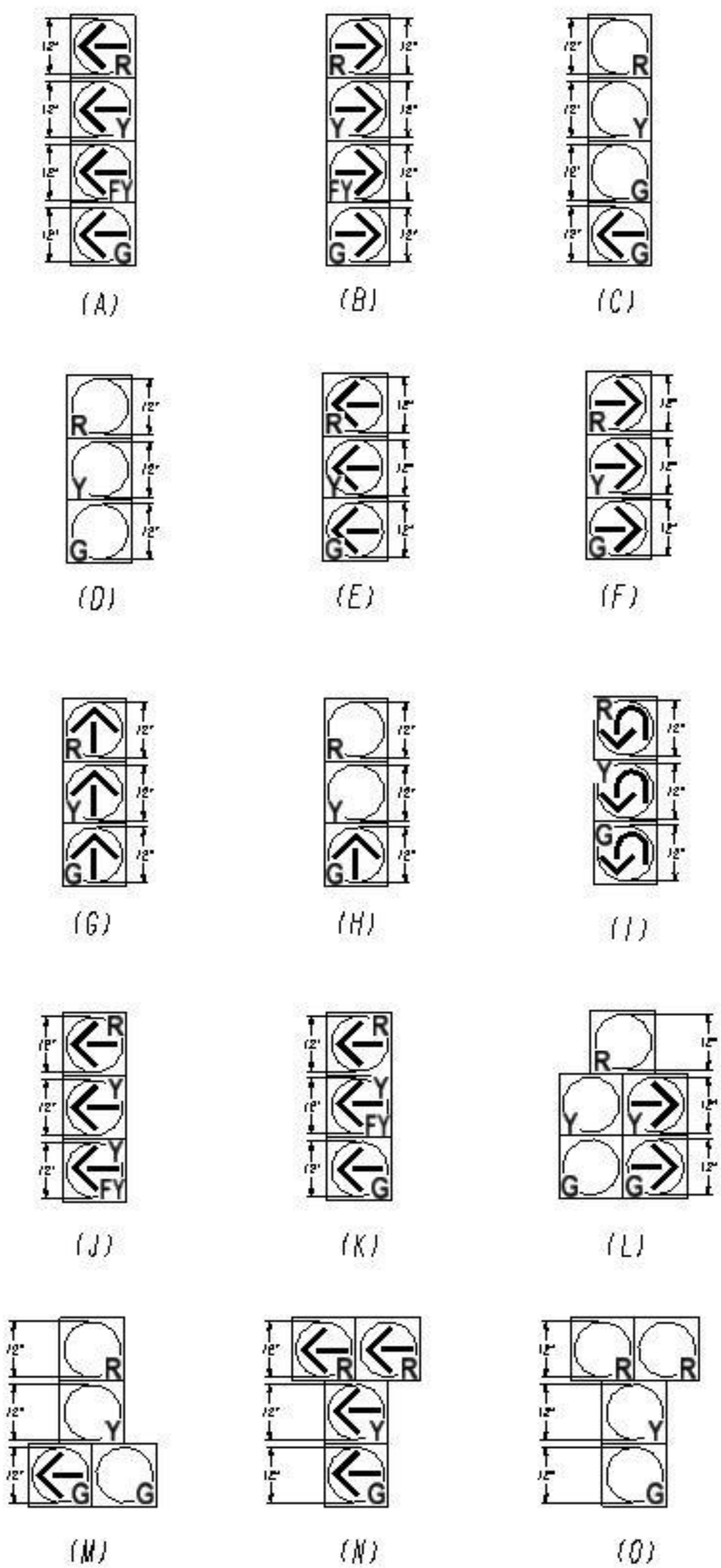


Figure D-1: Signal Head Detail Examples.